plating

JOURNAL
OF
THE
AMERICAN
ELECTROPLATERS'
SOCIETY

JULY - 1959

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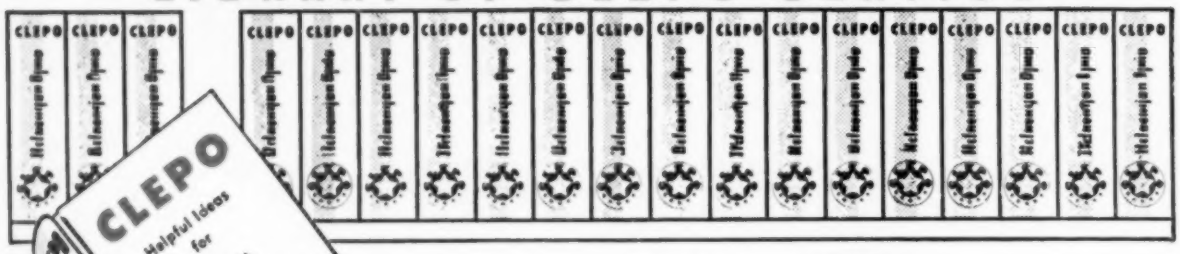

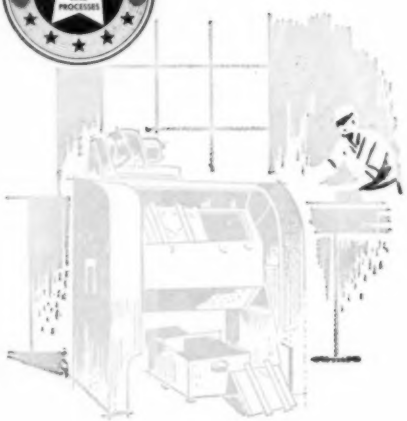

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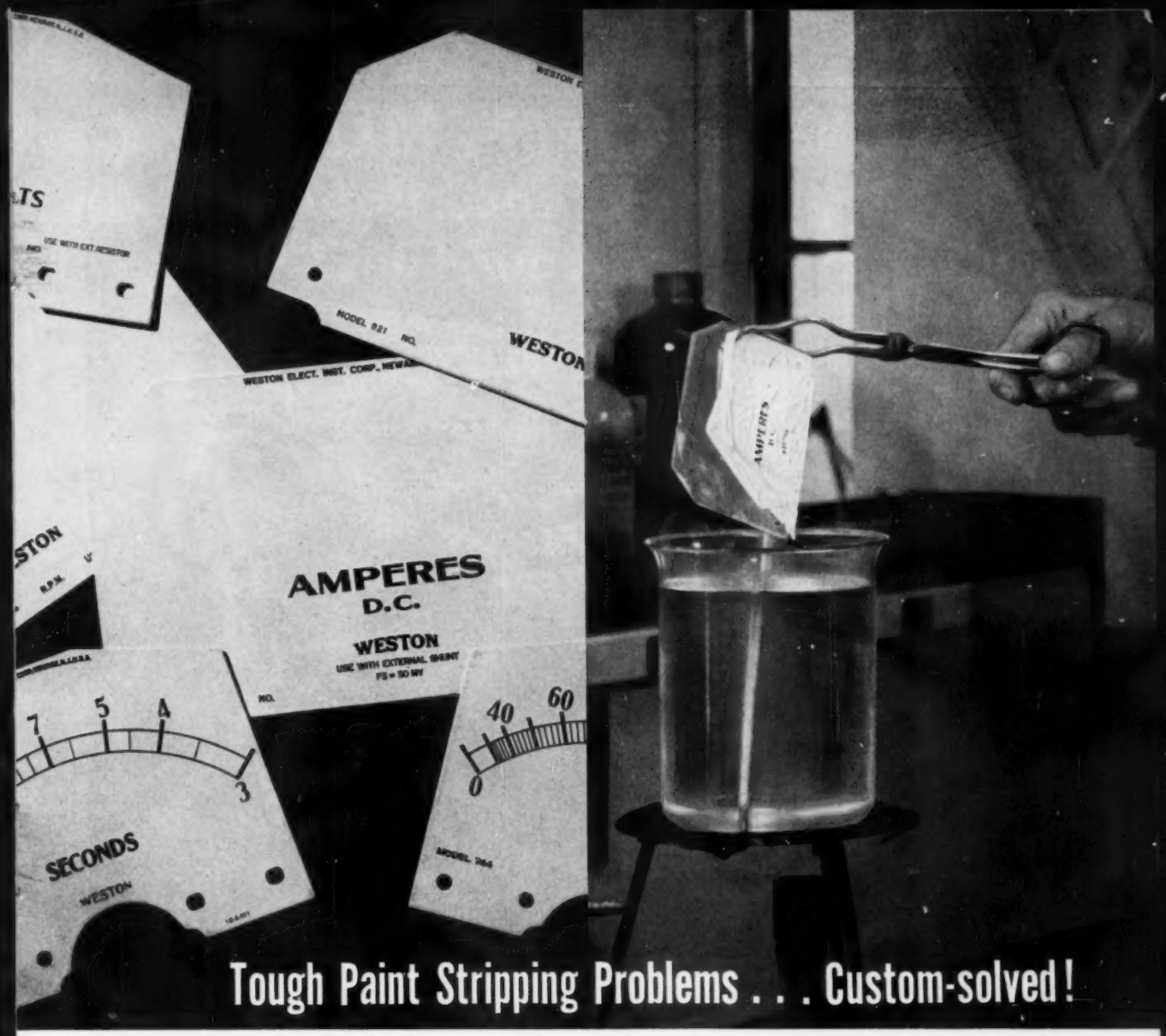

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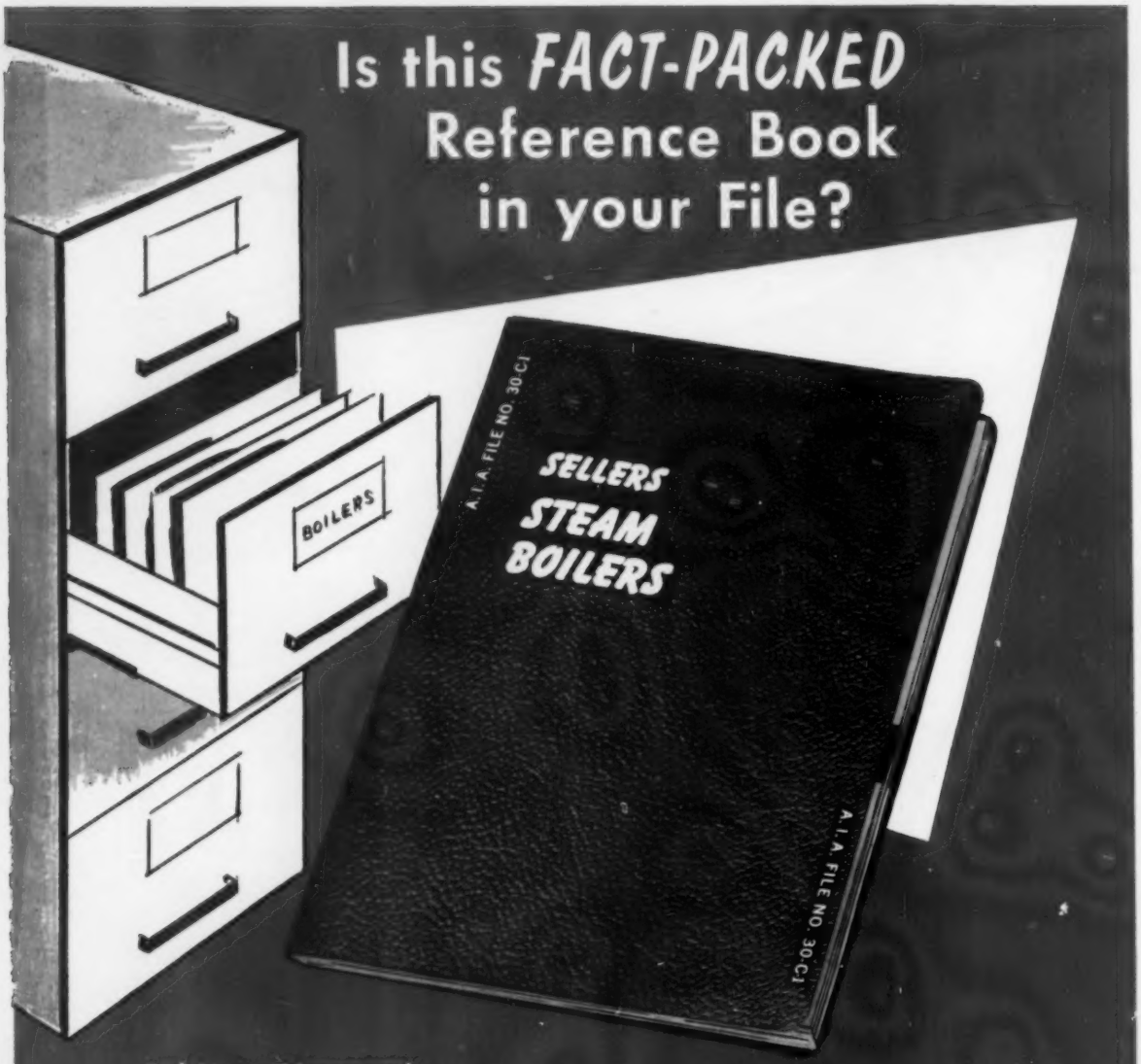

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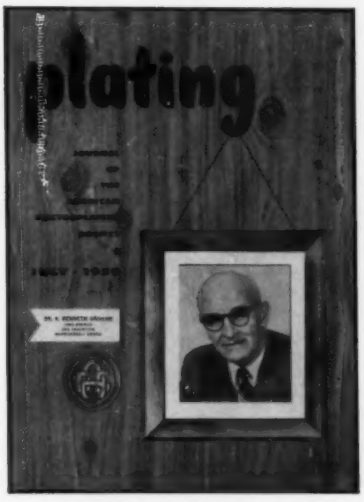

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plating
JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

JULY 1959 — **Vol. 46, No. 7**

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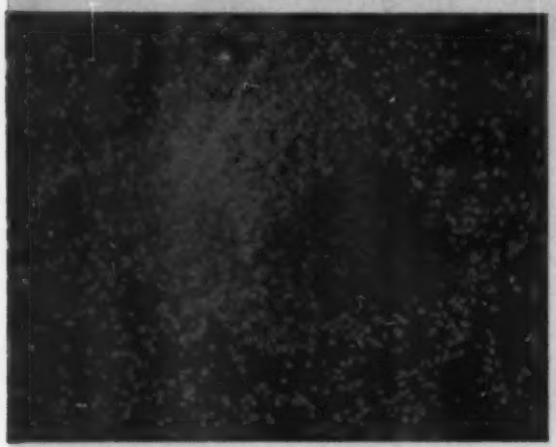

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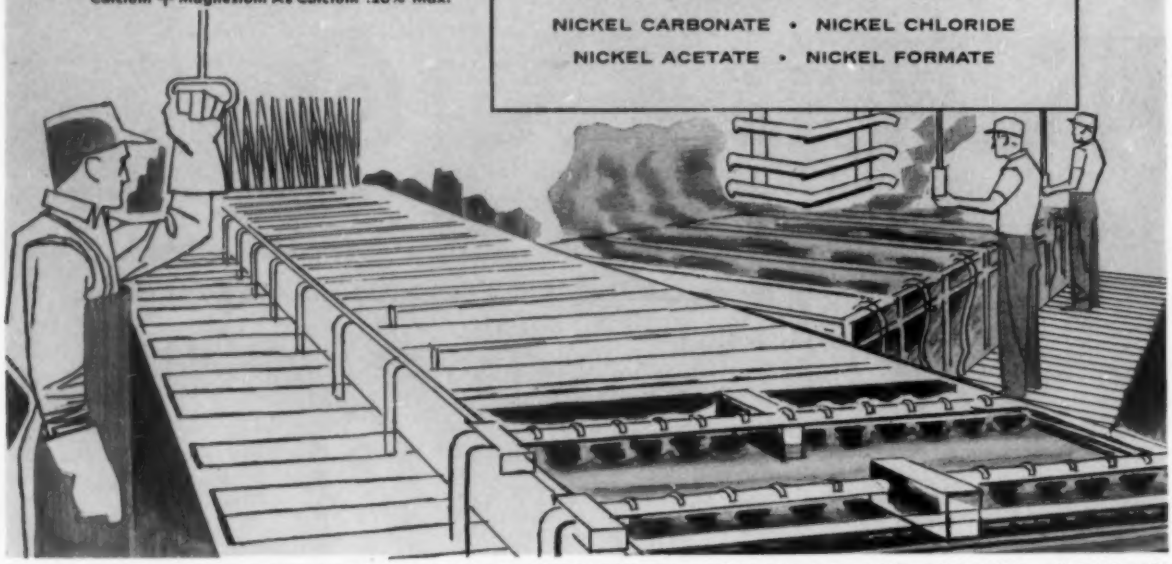


WRITE FOR FREE BOOKLET: HARSHAW'S COMPLETE SERVICE TO THE PLATING INDUSTRY

EDITORIAL

AFTER THE GOLDEN JUBILEE—WHAT?

THE AMERICAN ELECTROPLATERS' SOCIETY has just completed its fiftieth year of existence with the grandest of all its conventions, the GOLDEN JUBILEE Convention which included the Fifth Industrial Finishing Exposition and the Fifth International Conference on Electrodeposition and Metal Finishing. All during the year, Branches had special speakers at their meetings and regional gatherings, pointing their themes to the GOLDEN JUBILEE's basic meaning. Mayors of various cities proclaimed special American Electroplaters' Society weeks for their communities. Statesmen, governors, legislators and other distinguished persons sent us congratulatory messages during our celebration. The President of the United States did us the great honor of extending his greetings, a privilege that AES will cherish always.

Since 1909, our Society has been growing in stature as well as in membership, but never in all the fifty years of our existence was the attention of our nation and the world so keenly focused upon our actions and achievements as it was during this past year of 1958–1959. Throughout the year, we pointed with pride—and justly so—at how far plating and metal finishing had come and what AES had done in the past years. The great number of people who attended the Convention and Exposition bear witness to the fact that people from all over our continent and other parts of the world, believed what they had heard of the American Electroplaters' Society and, more important, believed in the American Electroplaters' Society.

The GOLDEN JUBILEE of our Society is to the Society, very similar to what the "Eagle Award" (Boy Scout's highest) is to a Boy Scout or a college diploma is to a young graduate. When a Boy Scout is awarded his "Eagle," he is told that all other Scouts will look upon him with respect and honor only so long as he continues to show, by his deeds and his words, that he deserves to keep what he has already won. Likewise, a young graduate with his diploma, applying for his first job, is told in no uncertain words that his degree does not excuse him from work or guarantee him an easy job. Quite the opposite is true, as he is expected to do more and better work because he has the knowledge and the capacity.

The American Electroplaters' Society, by its fostering of advancements in plating and metal finishing important to the public interest, is today enjoying a high plane of honor and respect with the industrial and educational institutions throughout the world. It cannot rest upon laurels already won, but must prove to all, that they are well-deserved and justly won by going forward to new and greater honors.

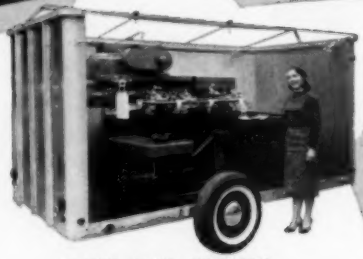
The challenge to the American Electroplaters' Society is self-evident. We have another year ahead of us, the first of another fifty years. Our research work must advance. Our monthly Branch meetings must be of the highest possible caliber so as to be of educational assistance to the Society's present members and to encourage new memberships. PLATING MAGAZINE must also continue to be of great service to all who read it.

Summing it up in a few words, we have attained a high standard and received high honors, making it necessary for the united efforts of all members and all Branches to continue our upward trend. As your newly elected President, I shall look forward to the privilege of your fullest cooperation, both as individuals and as Branches, to this mutually important end.

Ralph D. Wysong
President

"Little Steve" STARS AT A.E.S. EXPOSITION

NOW YOU CAN SEE "Little Steve" RIGHT IN YOUR OWN PLANT



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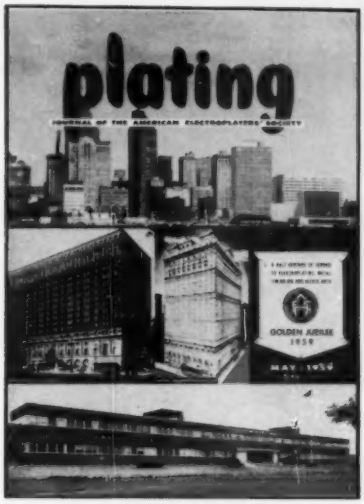
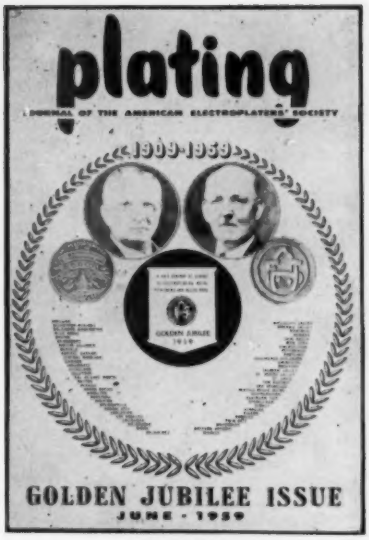


MAY 1959
GENERAL



JUNE 1959
GOLDEN JUBILEE

WHAT LIES AHEAD FOR PLATING MAGAZINE ADVERTISERS

JUST as a painting, a sculpture, a book can become a treasured possession, so too is PLATING MAGAZINE's unique GOLDEN JUBILEE Issue (June 1959) earning prized status in the reference libraries of thousands of key individuals who as the brain, muscle or sinew of electroplating and metal finishing establishments of all kinds, compose the very might of the industry globally.

And for PLATING, its GOLDEN JUBILEE ISSUE is but the vanguard of a veritable procession of important issues to come.

As an advertiser or as an advertising agency of a company seeking to reach the core of the purchasing power of the rich electroplating and metal finishing field, each of these significant PLATING MAGAZINE issues ahead should interest YOU as a medium for transporting your merchandising message to the heart of this fertile market.

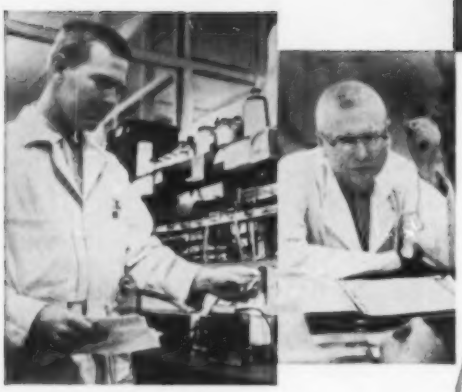
Aside from these monthly issues distributed to the largest paid circulation in this field, other values provided by PLATING MAGAZINE to its advertisers include, 1) lowest advertising rates, 2) stability demonstrated by the highest paid circulation renewal percentage in this field, 3) steadily burgeoning audience of prospective product buyers intimately, individually reached.

Without obligation of any sort, write or call PLATING's Advertising Department for a copy of its Rate Card and latest Publishers Statement for your comparison. Request a free copy of its popular "Market Data and Media File". Appraise, compare, then invest in PLATING MAGAZINE advertising. YOUR product and institutional merchandising will benefit from PLATING prestige, coverage, values.*

American Building, 443-445 Broad Street, Newark 2, N. J.
Phone: HUmboldt 2-3400

*Upon PLATING's acceptance of contract, and while its supply lasts, a handsome blue and gold easel (12" x 18") for displaying the company's own PLATING advertisements to its plant or office traffic is mailed free to each 1959 contract advertiser. Each regular advertiser, moreover, is also eligible to employ PLATING's direct mail service at nominal cost. Write for details.

plating leadership ✻



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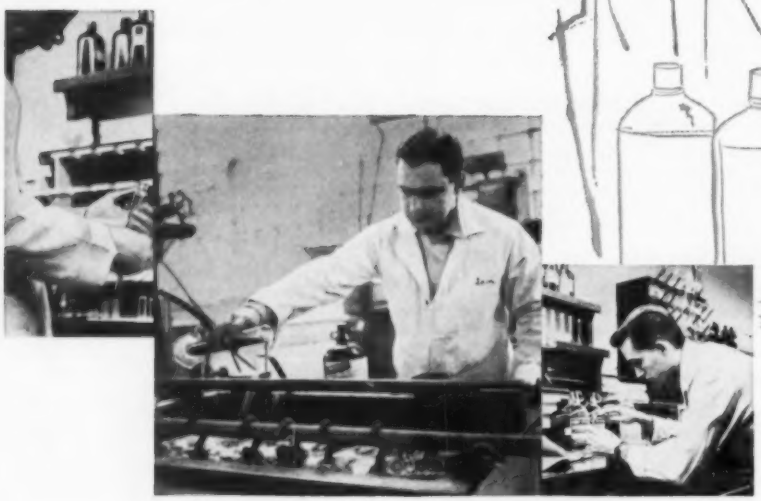

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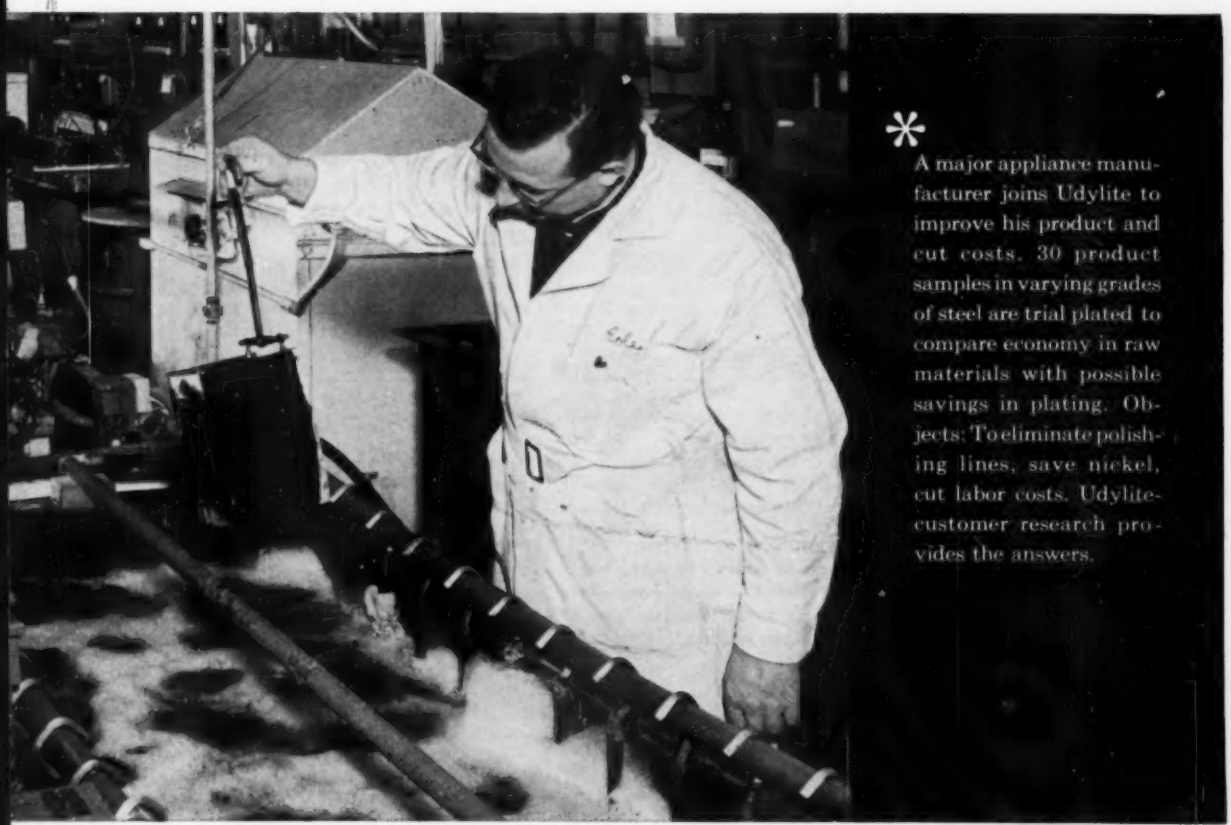
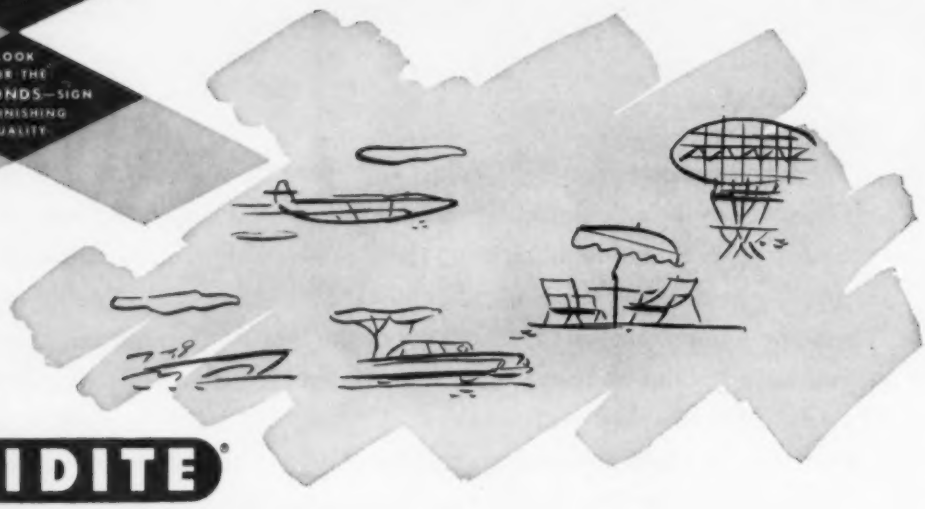


*A major appliance manufacturer joins Udylite to improve his product and cut costs. 30 product samples in varying grades of steel are trial plated to compare economy in raw materials with possible savings in plating. Objects: To eliminate polishing lines, save nickel, cut labor costs. Udylite-customer research provides the answers.

LOOK FOR THE DIAMONDS—SIGN OF FINISHING QUALITY



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5 RESEARCH AND DEVELOPMENT FACILITIES

If you have an unusual application, we will gladly work with you. Our entire staff of experienced engineers and chemists, and our completely equipped facilities are at your service.

IRIDITE—a specialized line of chromate conversion coatings for non-ferrous metals. Apply by dip, brush or spray methods — at room temperature — manually or with automatic equipment. Forms a thin film which becomes an integral part of the metal. Cannot chip, flake or peel. No special equipment, exhaust systems or specially trained personnel required.

If you are using chromate conversion coatings to finish zinc, cadmium, aluminum, magnesium, silver, copper, brass or bronze — consider the above benefits of Iridite. For complete information, contact your Allied Field Engineer. He's listed under "Plating Supplies" in the yellow pages. Or, write for FREE TECHNICAL DATA FILE.

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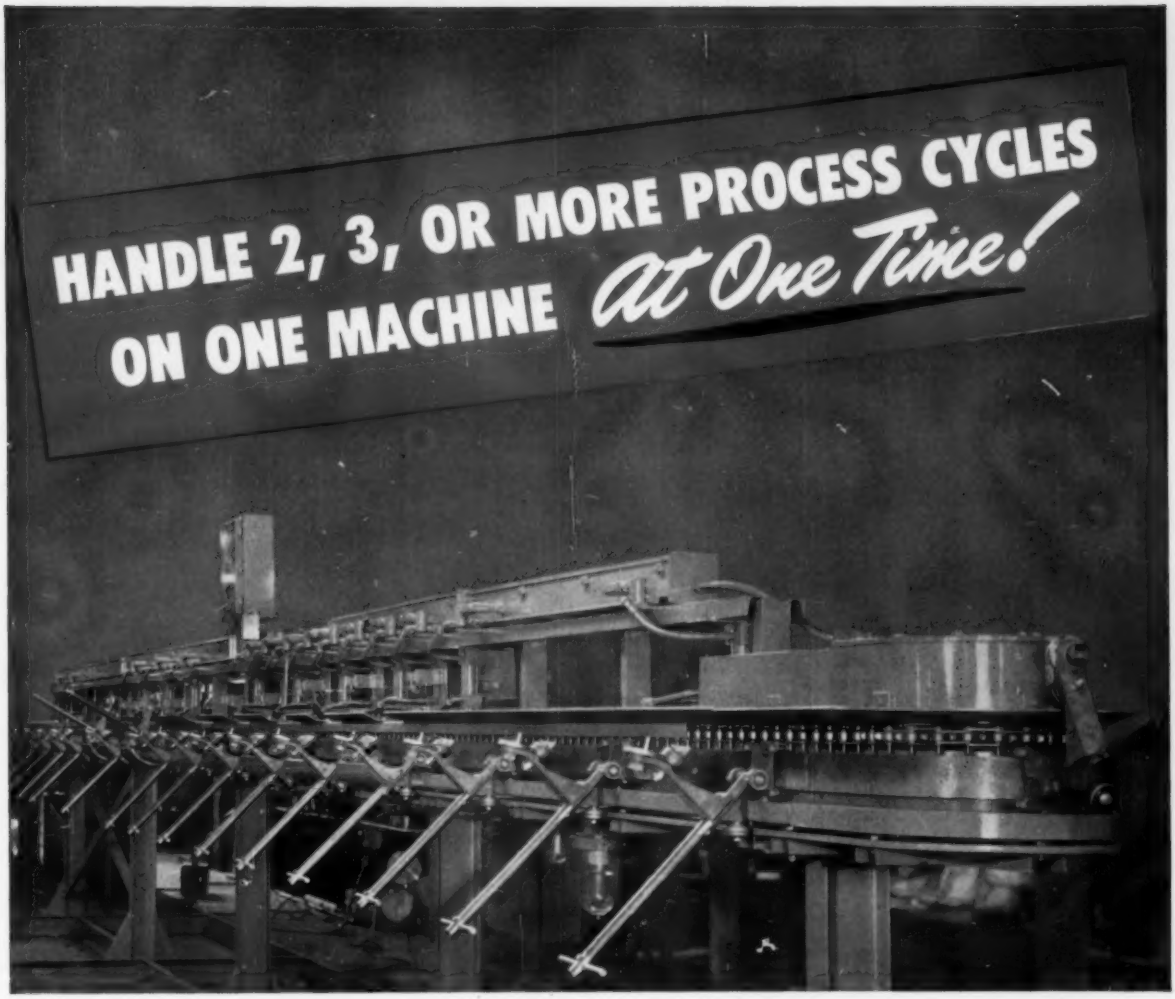
IRIDITE® Chromate Coatings | IRILAC™ Clear Coatings | ISOBRITE® Plating Brighteners | ARP® Chemicals & Supplies | WAGNER Line of Equipment



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for excellent brightness, levelling, and ductility at low cost

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FEDERATED METALS DIVISION

ASARCO

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NEW NORDALL emulsion cleaner locks out rust safely!

Here is a remarkable new emulsion cleaner that protects against rust longer — and without fire hazard, too! . . . Wyandotte's NEW NORDALL®!

Designed for spray cleaning steel, cast iron, and other metals either hot or cold, NEW NORDALL protects for up to *six weeks* in plant atmospheres. Perfectly suited for rust prevention between machining operations!

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FERLON®—Alkaline derusting compound removes rust, light scale, oil, grease, paint, smut without harm to ferrous metals.

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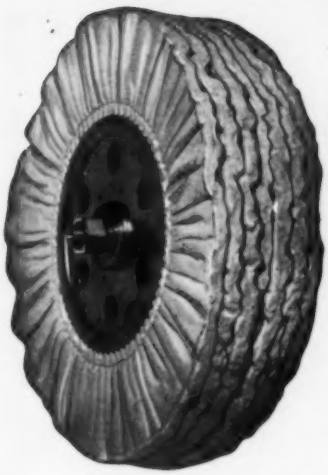

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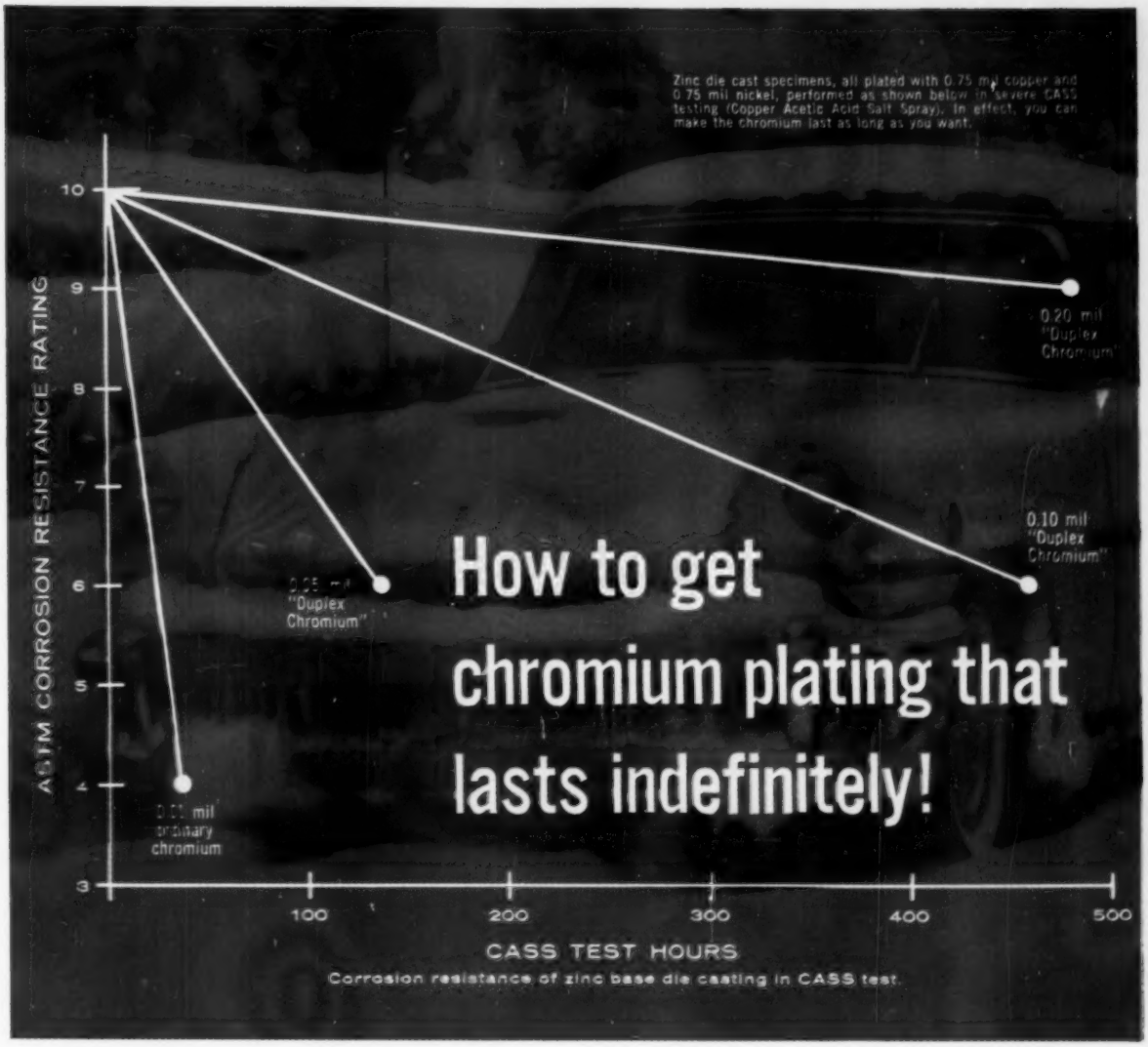
Zinc die cast specimens, all plated with 0.75 mil copper and 0.75 mil nickel, performed as shown below in severe CASS testing (Copper Acetic Acid Salt Spray). In effect, you can make the chromium last as long as you want.
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10
9
8
7
6
5
4
3
0.20 mil "Duplex Chromium"
0.10 mil "Duplex Chromium"
0.05 mil "Duplex Chromium"
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How to get chromium plating that lasts indefinitely!
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200
300
400
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Plate chromium thick enough . . . get a crack-free chromium base topped by a special, finely cracked chromium . . . assure more uniform plate distribution . . . and you can make the eye appeal of chromium last much longer than ever before!

You can easily meet all these requirements with M&T's fast processes for plating "DUPLEX CHROMIUM". Note the facts in the chart above. With the same thickness of undercoats in all cases, plating was done using Unichrome Crack-Free Chromium first with its more uniform and crack-free deposit; followed by a deposit of another Unichrome SRHS® Chromium with its *controlled* cracking. Just a few minutes additional plating time increases the protection tremendously. For example, in CASS, the time before ASTM rating dropped from 10 (which is perfect) to 8 (which is still acceptable to the customer) was multiplied as much as 20 times!

Plating M&T "DUPLEX CHROMIUM" poses no production problems. SRHS® solutions successfully deposit chromium on top of a previous chromium deposit. Thus by using *two* tanks, you can adapt present production equipment to give you thicker chromium with less trouble and cost than making changes in undercoats. "DUPLEX CHROMIUM" can handle a mixed variety of work in the same load, without need for frequent current adjustments, without burning on edges or missing in recesses.

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Bulletin 730-5430

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CYCLATOR® Clarifiers for clarification, precipitation and removal of toxic metals. Combines mixing, reaction, controlled slurry recirculation and solids separation in a single unit, with hydraulically operated skimmers when needed. Provides the highest degree of treatment in addition to saving space and cutting installation costs.

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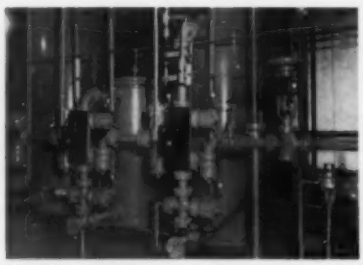
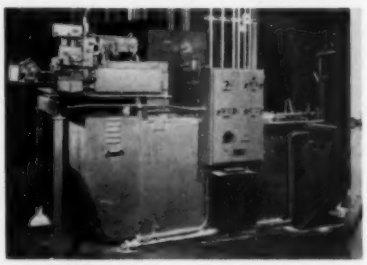


CATEXER ANEXER® Ion Exchangers for the recovery of chemicals and rinse water, and the purification of chromic acid as well as for softening or demineralizing process water. Pressure or gravity exchangers available for manual, semi-automatic or automatic operation.

Bulletin 1960-C



VISCOMATIC® Slaker hydrates lime completely with cold water. Water and quicklime are combined as a paste with true pug mill action. Torque control maintains constant viscosity assuring proper slaking with very little attention. Automatic grit washing and removal provides maximum lime recovery.

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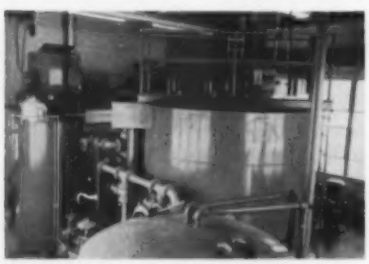

SEDIFLOTOR® Clarifier combines flotation and sedimentation in one compact unit. Particularly effective for the treatment of wastes containing greases, oils and light suspended solids. Provides maximum capacity in locations where space is limited.

Bulletin 6051

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Bulletin 9020-A

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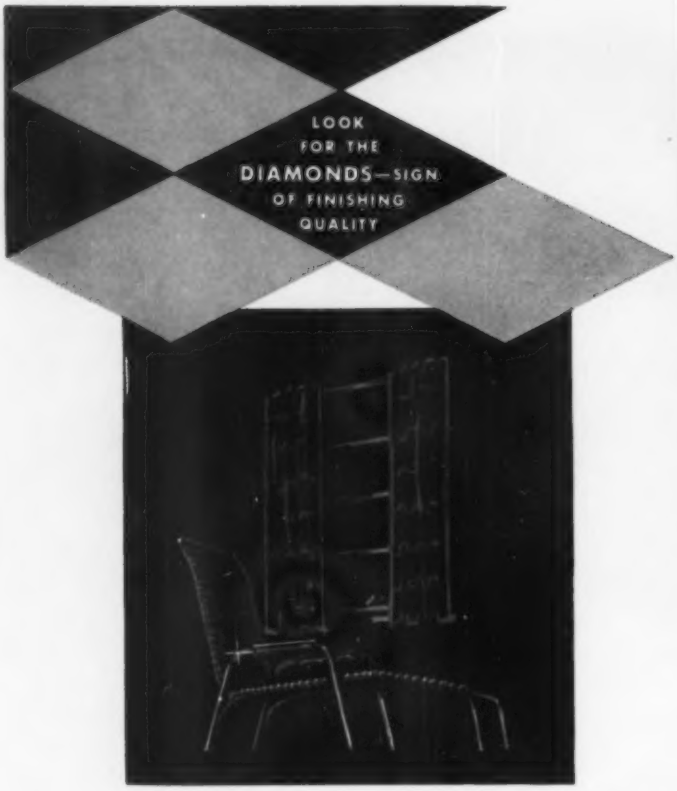

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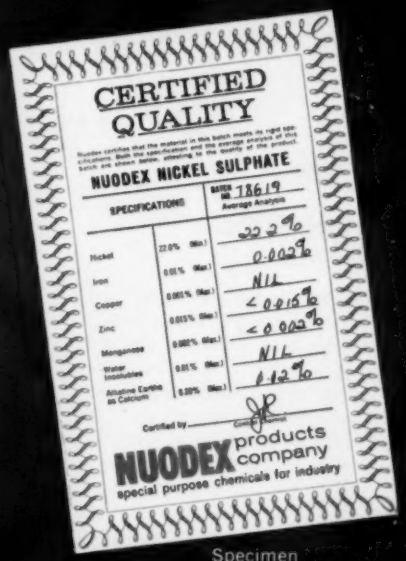
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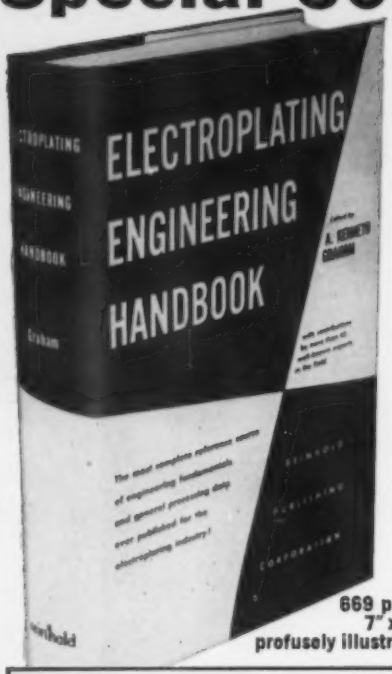

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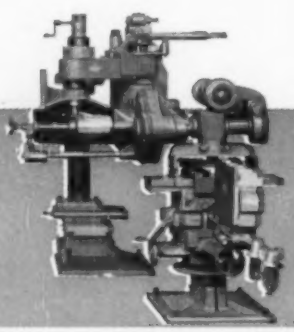

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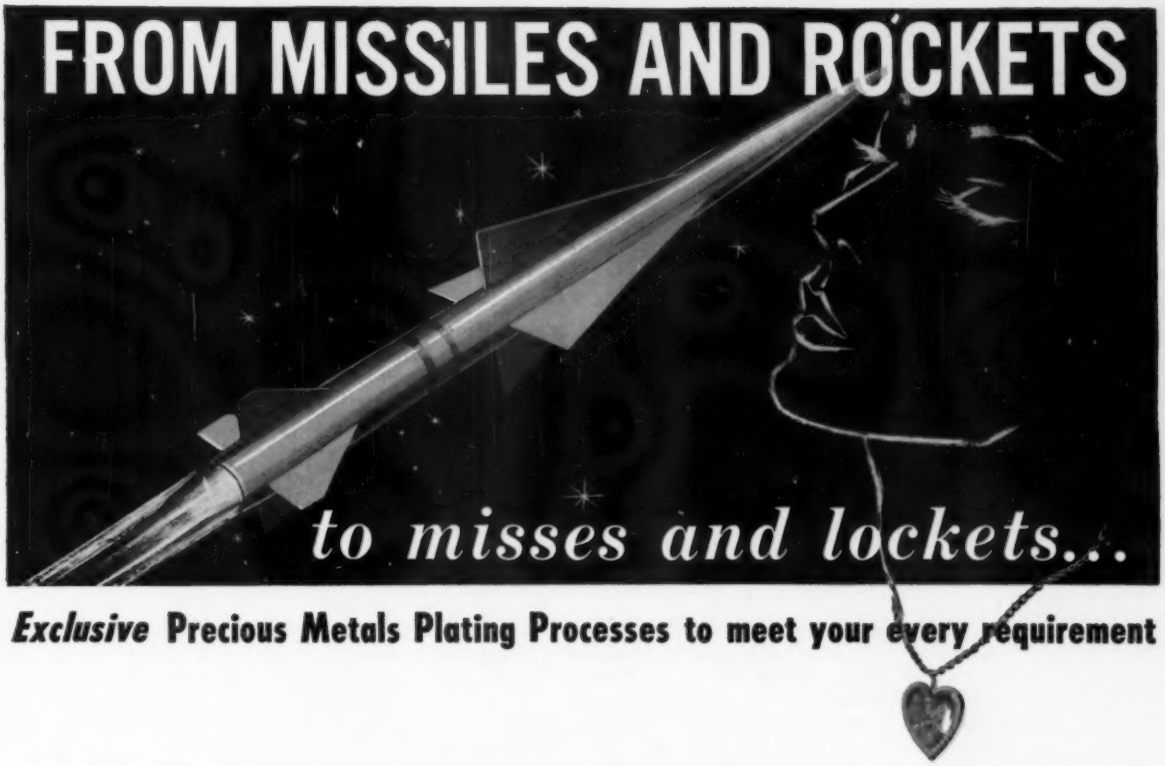

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THE INFLUENCE OF CATHODE FILM THICKNESS ON LEVELING

by SEWARD E. BEACOM*

An apparatus has been assembled which employs a shadowgraph technique to determine the effects of solution temperature, current density, and addition agents on the apparent thickness of the cathode film in nickel plating solutions. For both a Watts-type bath and a Watts-type bath containing two proprietary organic addition agents, the apparent cathode film thickness is directly proportional to current density and inversely proportional to temperature. The greater apparent cathode film thickness formed by a Watts-type bath containing two proprietary organic addition agents, in the valley of a notch, at a higher current density and at a lower temperature, parallels the conditions for maximum leveling which have been established previously for this same plating solution.

AMONG THE SEVERAL hypotheses which have been advanced to account for leveling action in the electrodeposition of metals such as copper and nickel is one which considers the influence of the thickness of the cathode film. Foulke,[1] who considers leveling to be a result of increased polarization at the peaks as compared to the polarization in the valleys of an irregular surface, suggests that the difference in polarization is dependent upon the difference in thickness of the cathode film at peaks and valleys. If the effective thickness of the film is greater in a valley than on a peak, then diffusion of addition agents to the valley is slow compared with diffusion to the peak. This point of view is further elaborated in the papers by Foulke and Kardos,[2] and by Kardos[3] who developed mathematically a theoretical basis for the assumption of a varying thickness of the cathode film. The review articles by Leffler and Leidheiser,[4] and by Fishlock,[5] also call attention to the possible influence of cathode film thickness on the leveling characteristics of certain nickel plating solutions.

The assumption of a varying thickness of the cathode film appears valid in light of the proposal that leveling is initiated by an increase in polarization on the peaks[2, 6, 7, 8, 9] which in turn is dependent upon a preferential adsorption of organic addition agents on these same peaks.[2, 6, 7, 8, 9, 10] Thus, a thicker cathode film in the valley of an irregular surface would slow down the diffusion of the addition agent to this region and therefore produce a polarization somewhat less than that existing at the peak. This would lead to enhanced deposition of metal in the recessed region.

In his work on leveling, Thomas[11] has shown that, for the particular proprietary nickel plating solution used, leveling was promoted by a decrease in temperature and an increase in current density. He also considered the effect of the cathode film thickness and, by employing an optical method, found that the thickness of the film decreased with an increase in temperature and increased with an increase in current density. His results for any difference in the cathode film thicknesses existing in a dull nickel solution (Watts type bath) as compared with a proprietary bright nickel solution were inconclusive. A consideration of these results suggested undertaking this study to obtain further evidence about the thickness of the cathode film and its possible influence upon leveling.

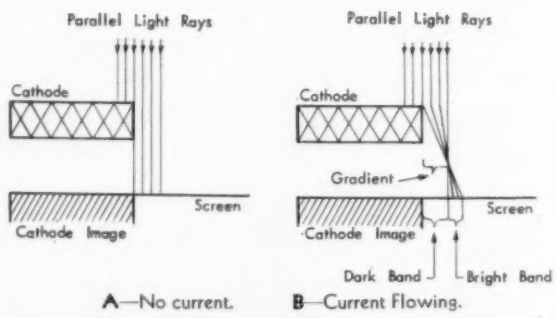


Fig. 1. Principle of film thickness measurement.

* Research Laboratories, General Motors Corporation, Warren, Michigan

Several methods have been employed by various investigators to measure the thickness of the cathode film. Among these might be mentioned the freezing method of Brenner,[12, 13] the schlieren technique of Stephenson and Bartlett,[14] the modified schlieren (shadowgraph) method of Yeager,[15] and the interferometric method of Ibl and co-workers.[16, 17] The shadowgraph method used in the present work is based on that of Yeager and is a refinement and extension of the work reported by Thomas.

THEORY OF THE SHADOWGRAPH METHOD

When an electrical current is passed through a solution in an electrolytic cell, concentration gradients are produced at both the anode and the cathode. According to theory, the concentration of metal ions should decrease rapidly across the relatively thin diffusion layer existing between the bulk of the solution and the cathode surface. In an attempt to measure the thickness of this diffusion layer, it is considered feasible to use a principle of optics which holds that parallel rays of light passing obliquely through a refractive index gradient are bent in the direction of greater refractive index. As a concentration gradient is produced in a solution adjacent to the cathode, a corresponding refractive index gradient is also established. This results in the bending of the light rays away from the cathode with the formation of an apparent cathode image (a dark band) and the concentration of the refracted rays into a bright band of light. This is the shadowgraph method in which the convergence of light rays produces a change in illumination which is approximately equal to the second derivative of the refractive index.[14, 18, 19] The analysis of data obtained is exceedingly complex and, consequently, in this paper, the width of the dark band obtained is considered as the *apparent thickness* of the cathode film. This interpretation, nevertheless, makes possible a comparison of the relative thickness of the cathode film as it varies under different conditions of temperature, current density, and solution composition. The shadowgraph method here employed is illustrated in Fig. 1—(a) with no current flowing and (b) with the current on.

APPARATUS

A. The Electrolytic Cell

The cell was made from two pieces of cold rolled steel (1.5 inches by 1 inch by 0.125 inch), one piece of electrolytic nickel (2 inches by 0.125 inch by 0.33 inch), two microscope slides (3 inches by 1 inch by 0.042 inch), Fiberglas cloth, an epoxy resin, and an iron-constantan thermocouple. The two pieces of steel were machined to size and the piece to be used as a cathode had a 90-degree notch 0.005 inch deep machined horizontally across the mid-point of its face. The piece to be used as the anode was sheathed on the electrode face with the nickel strip which was soldered to the long edges of the anode. A hole, 0.5 inch deep, was drilled in the cathode parallel to the cathode face and 0.25 inch from it. An iron-constantan thermocouple was welded in the hole.

The completed electrodes were bonded to the microscope slides with epoxy resin. The bottom of the cell was made from Fiberglas-reinforced epoxy resin. Fig. 2 is a photograph of the cell in position in the optical assembly.

B. The Microscope

The microscope has an objective of 16 millimeters and, when used in conjunction with the filar eyepiece, gave a magnification of about 100 times. The filar eyepiece was calibrated against a sub-stage micrometer and each filar unit was found to be equivalent to 0.00316 ± 0.00001 inch.

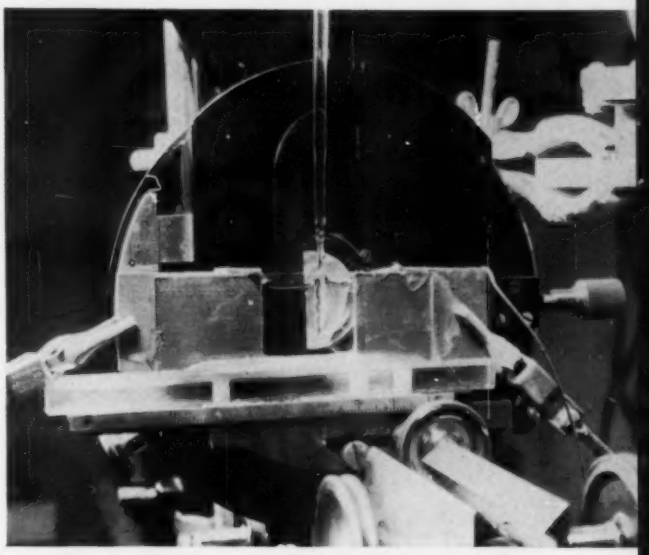


Fig. 2. Shadowgraph electrolytic cell.

C. The Light Source

A 25-watt "Point-o-Lite" zirconium arc served as a point light source. The beam of light was made parallel by reversing the substage lens and obtaining the correct distance relationship between the light source, the lens, and the electrolytic cell. The barrel of the microscope was removed and the substage lens adjusted until the beam of light became parallel, as observed in a darkened room by the Tyndall effect in the presence of some smoke.

D. Current Control Apparatus

The current source was an R. O. Hull electroplating rectifier unit. An Allen-Bradley carbon-pile resistor was used to control the current which was measured by a milliammeter. The current variation was ±0.1 millampere.

E. Temperature Control Apparatus

A Wheelco "Ampitrol" was used to control an infrared heat lamp positioned to act as an external heat source. The temperature variation was ±1F.

F. Photographs

A 4 × 5 camera, with bellows extended 18 inches (lens to film), and using Royal Pan Film, was employed for taking pictures through the microscope. At f4.5, a 1/10-second exposure of the cell was taken with the current off, and then another 1/10-second exposure was superimposed on the same film after the current had been on for one-half minute. The film was developed in DK-50 for seven minutes at 68F with intermittent agitation.

G. Apparatus Setup

The arrangement of the electrolytic cell, light source, and microscope on an optical bench, together with the auxiliary

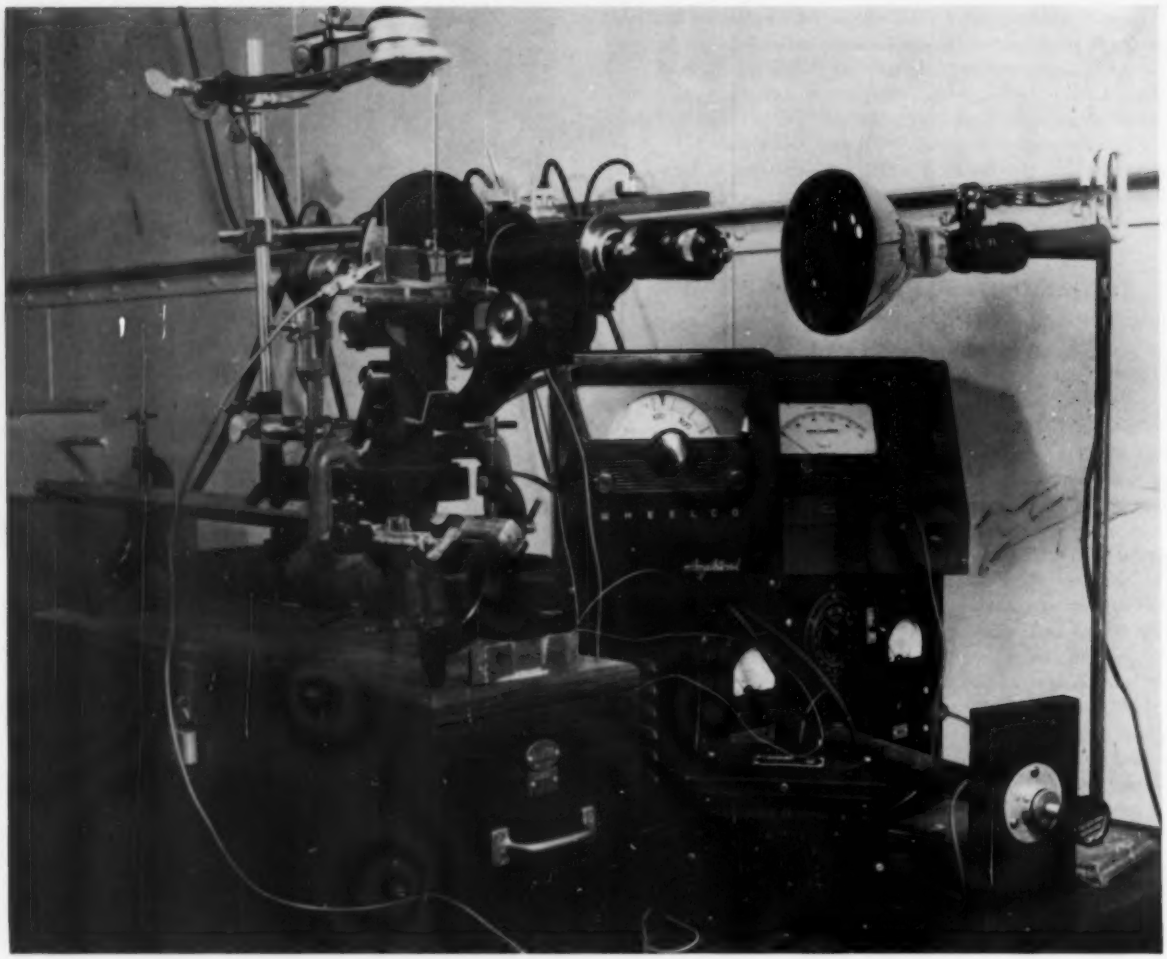


Fig. 3. Shadowgraph apparatus.

equipment, is shown in Fig. 3. (The stirrer shown in the photographs was *not* used for the results reported in this paper.)

EXPERIMENTAL

Two nickel plating solutions were used in this study. Bath A was a Watts-type solution containing nickel sulfate, 40 ounces per gallon; nickel chloride, 4 ounces per gallon; boric acid, 4 ounces per gallon; and a proprietary wetting agent, 0.65 fluid ounce per gallon. Bath B was prepared from the same basic solution as Bath A plus the addition of two proprietary organic addition agents, one an alkyl sulfonate, the other a quaternary ammonium salt. The starting *p*H of each solution was 3.0.

With the light source on, the cell was filled with the correct solution and brought to the desired temperature. The edge of the cathode was then brought sharply into focus by adjustment of the microscope, and the setting on the filar eyepiece was noted. Upon application of the required current density, the film thickness was measured on the flat just below the notch by the use of the filar eyepiece. The current was applied for at least one-half minute to reach a steady state, that is, the constant width of the dark band. (Thirteen milliamperes provided a current density of 20 amperes per square foot; 39 milliamperes were required for 60 amperes per square foot.)

In the experiment designed to measure the effect of current density on thickness, the current density was varied from 10 to 60 amperes per square foot at two temperatures, 100 and 150F. The effects of temperature were measured over the range 80 to 160F at current densities of 20 and 60 amperes per square foot.

In an attempt to show the possible relationship between cathode film thickness and the leveling ability of certain nickel plating solutions, film thicknesses were measured in the notch of the cathode and on the flats on each side of the notch (top and bottom).

RESULTS

The variation of apparent cathode film thickness with current density, and with temperature, is recorded in Tables I and II, respectively.

In Table III, the apparent cathode film thicknesses at the flats and valleys of the notched cathode have been tabulated to show the effect of type of bath, temperature, and current density. The data recorded in Tables I, II and III are the results of three different experimental runs. Each thickness is the average of three measurements.

If the data in Table III are used to calculate the per cent increase in film thickness from flat to valley when the current density is 60 amperes per square foot, the results obtained are shown in Table IV.

Some representative photographs of the cathode films as observed are shown in Fig. 4. The film is the gray area between the black cathode and the bright line of the converged light rays. (Note: The original 90-degree angle on the notched cathode has been altered by the plating which has taken place in the course of these experiments.)

CONCLUSIONS

Based on the above results, it is possible to draw the following conclusions:

1. For both Bath A and Bath B, the apparent cathode film thickness is directly proportional to current density and inversely proportional to temperature.
2. The apparent cathode film thickness in the valley is greater for Bath B than for Bath A.
3. The greatest apparent film thickness is found with Bath B in the valley at the low temperature and the high current density.
4. At the current density of 60 amperes per square foot, the percentage increase in the apparent cathode film thickness from flat to valley for Bath B is about twice that for Bath A.
5. The greater apparent cathode film thickness formed in the valley in the presence of Bath B may be related to the leveling ability of this bath.

DISCUSSION

The work of Thomas[11] has shown that a Watts-type nickel bath has zero leveling while a Watts-type bath modified by two proprietary addition agents provided positive leveling. In addition, it was shown that the leveling ability of the bright nickel bath was related to notch depth and angle, to solution temperature, and to current density. Consideration of the above variables showed that excellent leveling occurred on a 90-degree shallow-notched cathode, at low temperature and at high current density. The assumption has been made in the present study that Bath A is zero leveling while Bath B is positive leveling. The greatest apparent cathode film thickness was produced by Bath B, in the valley of the cathode at the lower temperature and the higher current density. These factors parallel the conditions for maximum leveling as established by Thomas for the particular proprietary solution used.

If it can be assumed that the leveling process is initiated by an increase in polarization on the peaks, which in turn can be caused by a preferential adsorption of organic addition agents on these same peaks, then it appears possible to relate cathode film thickness to the leveling phenomenon. Furthermore, it must be considered that the very existence of the cathode film depends upon the complicated interplay of the hydrodynamic characteristics of the solution itself, including ordinary diffusion and convection phenomena, and the diffusion brought about by the presence of electric fields.

At a current density of 20 amperes per square foot, the apparent cathode film thickness is less in the valley than on the flat. There seems to be no satisfactory explanation for this observation. Nevertheless, there may be relatively rapid transfer of the organic addition agents through this thinner layer to produce a rather uniform polarization of both peaks and valleys. Such a condition would not lead to leveling.

TABLE I
APPARENT FILM THICKNESS VS. CURRENT DENSITY

Current Density	Bath A		Bath B	
(Asf)	100F	150F	100F	150F
10	0.00291 in.	0.00220 in.	0.00248 in.	0.00232 in.
20	0.00570 in.	0.00426 in.	0.00618 in.	0.00426 in.
30	0.00650 in.	0.00488 in.	0.00670 in.	0.00488 in.
40	0.00690 in.	0.00552 in.	0.00725 in.	0.00559 in.
50	0.00690 in.	0.00556 in.	0.00733 in.	0.00591 in.
60	0.00710 in.	0.00579 in.	0.00764 in.	0.00618 in.

TABLE II
APPARENT FILM THICKNESS VS. TEMPERATURE

	Bath A		Bath B	
Temperature (°F)	Current Density 20 Asf	Current Density 60 Asf	Current Density 20 Asf	Current Density 60 Asf
80	0.00611 in.	0.00698 in.	0.00634 in.	0.00780 in.
100	0.00587 in.	0.00686 in.	0.00618 in.	0.00760 in.
120	0.00556 in.	0.00634 in.	0.00540 in.	0.00724 in.
140	0.00493 in.	0.00606 in.	0.00457 in.	0.00674 in.
160	0.00433 in.	0.00599 in.	0.00410 in.	0.00634 in.

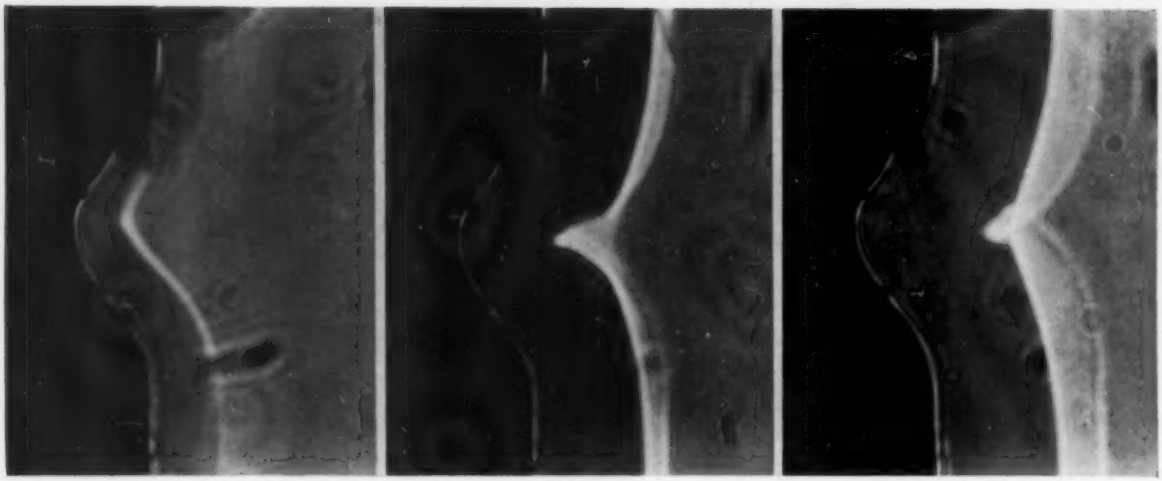
TABLE III
APPARENT CATHODE FILM THICKNESS AT FLAT AND VALLEY

		Current Density 20 Asf	Current Density 60 Asf
Bath A (Notch, 0.005 in.)			
100F	Flat	0.00512 in.	0.00690 in.
100F	Valley	0.00366 in.	0.00788 in.
150F	Flat	0.00445 in.	0.00638 in.
150F	Valley	0.00307 in.	0.00686 in.
Bath B (Notch, 0.005 in.)			
100F	Flat	0.00548 in.	0.00698 in.
100F	Valley	0.00441 in.	0.00890 in.
150F	Flat	0.00445 in.	0.00654 in.
150F	Valley	0.00386 in.	0.00760 in.

TABLE IV
INCREASE IN APPARENT CATHODE FILM THICKNESS FROM FLAT TO VALLEY AT CURRENT DENSITY OF 60 ASF

Bath	Temperature, °F	Thickness Increase, Per Cent
A	100	14.2
A	150	7.5
B	100	27.5
B	150	16.2

In marked contrast, a current density of 60 amperes per square foot produces a reversal of apparent cathode film thickness leading to a greater thickness in the valley than on the flat. Mass transfer may now be more electric field dependent than convection dependent, and may be intimately



(A) 150F, 20 asf (B) 150F, 60 asf (C) 100F, 60 asf

Fig. 4. Cathode films on notched cathode.

related to the electrical characteristics of the organic addition agents. At this higher current density, there will be a rapid decrease in the metal ion concentration near the electrode surface. To replenish this deficit of ions, it is necessary for the cathode to extend its influence farther out into the bulk solution. This results in increased cathode film thickness, and under these conditions, there is a slower transfer of the addition agents to the valley. Consequently, the lower polarization in the valley leads to more metal deposition in this region and brings about leveling.

This description implies that the influence of the electric field is different for the addition agents than for the metal ions. It is known, for example, that the diffusion of organic molecules which are simple dipoles is proportional to the first derivative of the electric field strength while the diffusion of ions is proportional to the electric field strength itself. Herein may be the explanation for the observations which have been made in this study. It must be emphasized that these results have been obtained for a particular proprietary plating solution and they may or may not be extended to cover other situations. It is recognized that these phenomena are not completely understood, but it is hoped that this work may stimulate further investigation along these lines.

ACKNOWLEDGMENT

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Dr. Seward E. Beacom has been a senior research chemist in the Electrochemistry and Polymers Department of the General Motors Research Laboratories since 1957. He holds the BS degree from Mount Union College, the MS degree from the University of Michigan, and the PhD degree from the University of Connecticut, all in chemistry. He was formerly an instructor in chemistry at the University of Michigan and Associate Professor of Chemistry at the Teachers College of Connecticut. His industrial experience includes work with the Chevrolet Motor Division of General Motors Corporation, Union Carbide Research Laboratories, The Stanley Works, and Pratt and Whitney Aircraft. He is a member of the American Electroplaters' Society, the American Chemical Society, the American Association for the Advancement of Science, and is secretary-treasurer of the Detroit Section of The Electrochemical Society.

Fig. 1. Ampere hour meter controlling additions to a 2000-gal nickel tank.

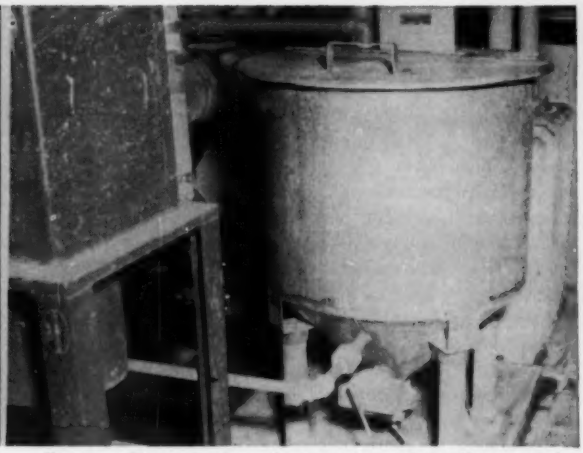

Fig. 2. Chemical salts tank containing nickel sulfate, nickel chloride and sulfuric acid. The pump is below and behind the tank.

AUTOMATIC ADDITIONS OF ALL CHEMICALS TO THE NICKEL PLATING BATHS

by **MITCHELL G. OSMAN***

The manufacturing of phonograph records is dependent on the art of electroforming. Small quantities of impurities in the bath can cause variation in the physical properties of the electroformed plate. Also, the composition of the solution should be as constant as possible in order to maintain consistent results. With an increase in stress, the electroformed deposit pulls away from the part being duplicated resulting in deformation of the surface. Some impurities tend to lower the stress. To control impurities, pH, and salt concentration more uniformly, automatic addition equipment was developed to add all chemicals to the nickel bath. The automatically controlled units, along with the water level control, add all ingredients to the plating bath except the anode and the cathode. These are placed in the tank in the conventional manner.

I. MANUFACTURING OF PHONOGRAPH RECORDS

A PHONOGRAPH RECORD begins with the recording of the artist's work. The sound is then transferred to a lacquer disc by a recording stylus which cuts the sound waves normal to a circular path spiralling in towards the center. Thus the grooves of the record disc have been created. In order to mold phonograph records a metal negative of the lacquer surface is required. The only method at present suitable for duplicating the surface down to less than the necessary one microinch detail is electroforming. Duplication is done in four steps, the final step being the finished product—a phonograph record—preserving in this form the work of great artists to be enjoyed by ourselves and generations yet unborn.

The four steps used in manufacturing phonograph records represent one method generally used. There are other processes which are not discussed here.

The FIRST STEP is to produce a master or negative part of the lacquer disc. A silver film is precipitated on the surface by a modification of the process used to silver mirrors. This gives an electrically conductive surface from one to three millionths of an inch in thickness—the starting point for the electroforming process. It is then built up in thickness by first plating nickel, then copper, thus forming a laminated metallic master which, after separation from the lacquer disc, can be used for further duplication.

* Process Engineer, RCA Victor Division, Radio Corporation of America, Indianapolis, Indiana.

The nickel plate is approximately from three to five mils thickness. This is electroformed over the silver deposit, which is the base metal. Very close control of the nickel bath must be maintained at this point because the silver is loosely held onto the lacquer surface. The current density is maintained at 20 amperes for 45 minutes. An acid dip and water rinse are used just before placing the part into a high speed acid copper tank. Electroforming takes place at approximately 110 amperes per square foot. The desired thickness is 0.025 inches. This electroformed laminated plate is now separated from the lacquer disc. The laminated plate is now called a "master" and could be placed in a hydraulic press and used to mold a phonograph record. However, because of the large quantity of records required, many presses must be in operation simultaneously. Therefore, negatives of this negative master must be produced by the process of electroforming. In order to do this, metal positives sometimes called "mothers" or molds are made. The SECOND STEP in the process is, therefore, the production of the mothers and essentially is the same as the method for producing the negative masters. It consists of treating the surface of the master in order to control adhesion and then nickel plating and copper plating by the same process described above. These positives or mothers can be played and tested for audio defects because they are similar in profile to the original lacquer disc.

In Europe the term "father" and "mother" are used frequently to denote the master and mold respectively. The term "mother" is used because the part can be duplicated again and again for electroforming the next generation, called stampers. Production of the stampers then is the third step in the process. The final and FOURTH STEP is the use of the stampers as master dies for molding the final product—the phonograph record.

II. ELECTROFORMING PROBLEMS

In duplicating the negatives and positives by the process of electroforming, little or no adhesion must be maintained. If adhesion is too great, the parts cannot be separated and are scrapped. If adhesion is insufficient, the internal stresses of the deposit will cause the parts to separate prematurely. Because there is little or no adhesion, a variation in the internal stresses of the deposit will cause parts to be defective.

TABLE I

TYPICAL REPLENISHMENT REQUIREMENTS
Tank Volume 1430 Gal

Chemical	Normal Concentration	Addition/amp-hr
Nickel sulfate	40 oz/gal	0.0042 oz
Nickel chloride	3.80	0.0004 oz
Boric Acid	5.25	0.0006 oz
Sulfuric acid	pH 4.0	0.0220 ml
Wetting agent—		
Duponol		0.0020 oz
Stress reliever—		
Saccharin		0.0010 grams

Note: Small amounts of chemical additions are made once per week based on analysis since depletion rate is not absolutely linear with ampere hours.

The Watts nickel plating bath is considered by most platers as a stable solution; however, when this is reviewed from the standpoint of record electroforming, it can be quite temperamental. When a nickel plate is deposited to 0.010 inch or thicker over a flat area of 200 square inches having practically no adhesion to the starting surface, problems unknown in the decorative plating field develop. The newly formed plate must not be too adherent to the part being duplicated because it must be separated and the original put through the duplicating process several times without deterioration of the surface.

Small quantities of impurities in the bath can cause changes in the internal stress of the electroformed plate. With an increase in stress the electroformed deposit pulls away from the part being duplicated, resulting in deformation of the surface. Some of these deformations are described as slipped nickel, blisters, double nickel and a few other terms peculiar to the record industry. Some impurities tend to lower the stress which causes a peculiar deformation called "crows feet" or "spider web." Actually these defects are localized buckling. Therefore, it is extremely important to keep impurities in the solution at a constant minimum level.

Continuous electrolytic purification of the nickel baths has

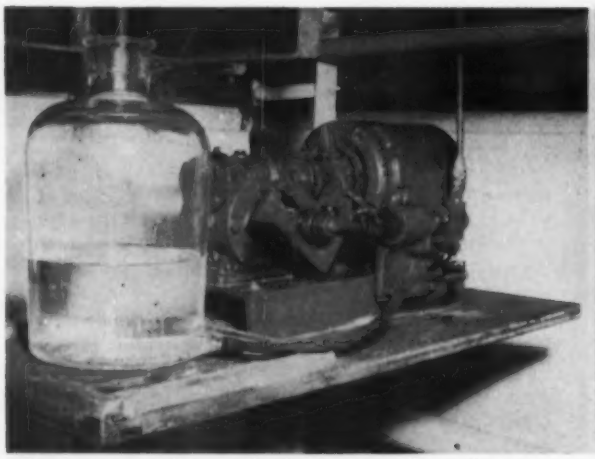

Fig. 3. Pump and storage bottle contains additions for controlling stress and surface tension.

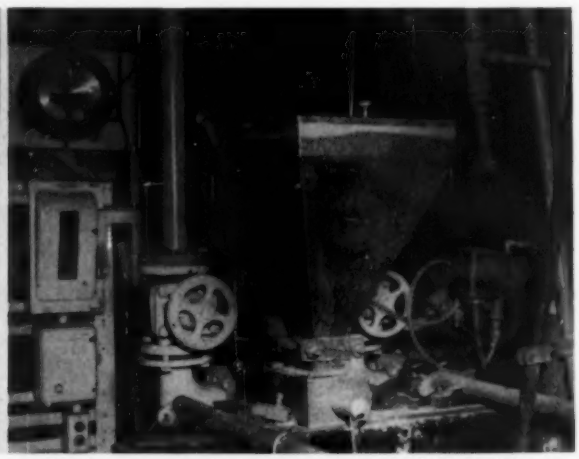

Fig. 4. The dry feeder hopper stores and feeds filter aid, boric acid and carbon. A small stream of chemicals can be seen dropping into an electrolytic purification tank, part of a large automatic plating machine.

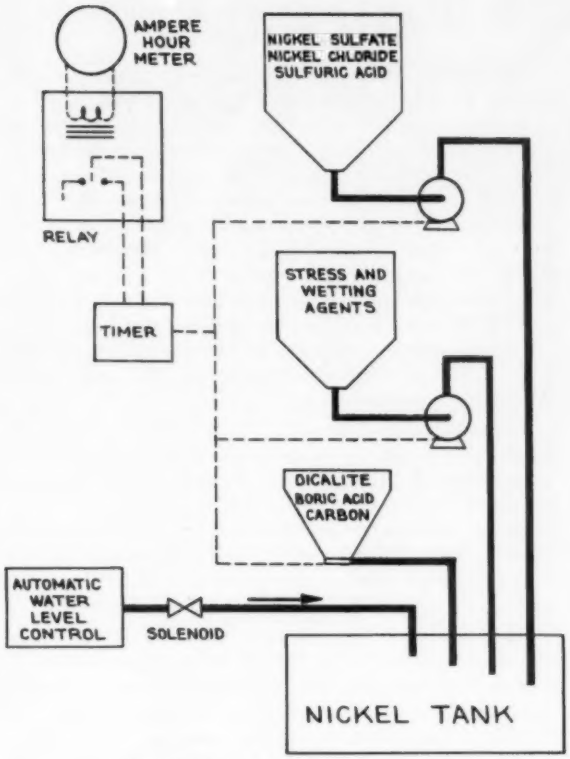

Fig. 5. Automatic addition flow plan.

long been used to maintain the metallic impurities at a low level. Commerical nickel plating salts are relatively impure. Quite often the manual addition of these impure nickel salts raised the level of the total impurities to such an extent that the electrolytic removal rate was exceeded. As a result, poor quality plating was expected for several hours. Sometimes it would be necessary to purify the solutions before putting the tanks back into production.

III. DEVELOPMENT OF AUTOMATIC EQUIPMENT FOR ADDITIONS OF ALL CHEMICALS TO THE PLATING BATH

In order to avoid the effect of large additions of salts and a consequent large addition of impurities to the nickel bath, automatic feeders were developed to control and proportion the amount of material to be added to the plating bath. The quantity of material added is based on the ampere hours used in the plating tank. In this manner the additions are proportioned to the depletion rate, despite the fluctuation due to a variable production rate from shift to shift or day to day.

Several systems were considered. One was the conventional slurry tank. The principal objection to this equipment is its well-known maintenance problems caused by clogging of the piping with the solid filter aid. For this reason the soluble materials were then kept separate from the insoluble material to be added to the plating bath. When first testing the equipment with the soluble salts, the boric acid solution crystallized out and formed a hard mass. The boric acid was then put into a dry feeder along with the filter aid. A solution tank and pump were used to feed a solution of nickel chloride, nickel sulfate and also the sulfuric acid for *p*H control. A

TABLE II

ALLOWABLE STRESS LIMITS IN ELECTROFORMED DEPOSITS

Residual Stress in deposits measured by Brenner Senderoff Contractometer

Plating Step	Type of Plating Bath	Current Density	Stress Limits
Master	Nickel	20 asf	4000– 8000 psi
	Copper	110 asf	
Mother	Nickel	20 asf	1000– 4000 psi
	Copper	110 asf	
Stamper	Nickel	75	12000–15000 psi

All internal stress measurements are positive (tensile) measurements. Occasionally negative (compressive) stresses occur.
The surface tension is maintained at 37 dynes/centimeter. The limits are ± 2 dynes/centimeter measured on a Cenco-du Nouy Tensiometer. The automatic equipment will maintain the surface tension at ± 1 dyne/centimeter.

second small tank and pump were used to maintain the surface tension and minimize stress by the addition of a surface active material and a stress relieving agent. It was found necessary to separate the wetting agent from the chemical salts tank because air agitation was used to dissolve the salts and this caused excess foaming.

The major components of the system finally used can be seen in Figs. 1, 2, 3 and 4. They consist of three units controlled by an ampere hour meter. These automatically controlled units along with a constant level control add all ingredients to the plating bath except the anode and cathode, which are placed in the tank in the conventional manner. The complete system, The automatic addition flow plan, is shown in Fig. 5. Two chemical tanks and one dry feeder are controlled by a totalizing ampere hour meter. These units are sized so as to hold a 24-hour supply of chemicals at full operating loading. The ampere hour meter seen in the upper left hand corner is designed to close a circuit and make a contact 125 times in 24 hours. The contact in turn energizes the timer by means of a guardian relay. This is an interlocking double relay necessary because of the slow motion of the ampere hour meter contacts. The timer determines the length of time the pumps and dry feeder operate for each contact of the ampere hour meter. Thus adjustments in addition rates can be made by adjusting the timer or by changing the concentration of the stock solutions. The larger chemical

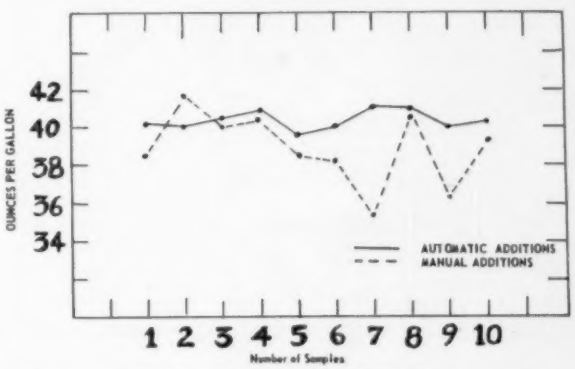

Fig. 6. Effect of manual versus automatic additions on nickel sulfate concentration.

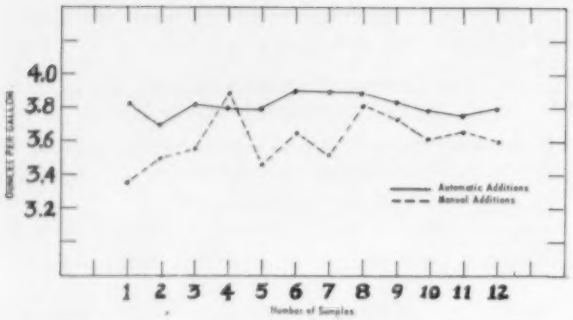

Fig. 7. Effect of manual versus automatic additions on the nickel chloride concentration.

tank and pump at the top of the chart feeds a solution of nickel sulphate, nickel chloride and sulphuric acid. A baffle is built into the side of the tank and covers the opening to the pump and prevents the salts from entering the pump or piping which would prevent the flow of solution. The baffle also serves to form a separate compartment for dissolving the salts by use of air agitation. The chemicals are added daily. This usually requires from five to ten minutes of a laboratory technician's time. He fills the hoppers and dissolves the salts each day.

The dry feeder seen just above the plating tank feeds the boric acid and the filter aid. Difficulty in designing the dry feeder was experienced because of the tendency of the diatomaceous filter aids to pack and bridge, but with the use of a vibrator and worm type feeder the difficulty was overcome. There are now satisfactory feeders of this type available in the size required for small installations.

In the center of Fig. 5 there are a proportioning pump and a one-gallon tank which store and feed the wetting agent to control surface tension and also add a stress relieving agent. Originally the wetting agent was put into the large chemical tank with the nickel salts but because the air agitation caused excess foaming a separate tank for wetting agents is now employed.

Last but not least in importance is the level control by which deionized water is added to the plating bath. Two types of level controls are used: (1) the old float valve which has been used for years, and (2) the modern electronic capacitor type of control. The manual addition of as much as five gallons of water to a 250-gallon tank has many times caused the rejection of an entire tank load of metal parts because of the effect on the internal stress in the deposit.

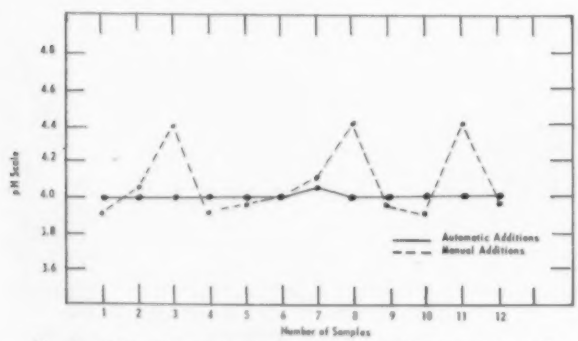

Fig. 8. Effect of manual versus automatic additions on the pH of the nickel solution.

IV. RESULTS OF AUTOMATIC ADDITIONS OF ALL CHEMICALS

The performance of this equipment with respect to maintaining *p*H, nickel sulfate and nickel chloride can be seen in the accompanying charts. The graph in Fig. 6 gives the analysis for nickel sulfate. The solid line shows the analysis taken for a one-month period with the use of automatic controls. The desired concentration of nickel sulfate is 40 ounces per gallon in this particular plating bath. Ten analyses were made during the month and three of these were at the desired concentration. The other seven analyses had a range of 1.5 ounces per gallon. The dotted line made over approximately the same length of time demonstrates how difficult it is to maintain the concentration by daily manual additions when the production rate is fluctuating. The range here is seven ounces per gallon.

The maintenance of the nickel chloride concentration can be seen in Fig. 7. The curve for the automatic additions shows that the range for the analyses is 0.1 ounces per gallon and that approximately one-third of the analyses were at 3.8 ounces per gallon, which is the specification for this particular plating solution. The curve for manual additions shows only one analysis at the desired concentration, and that the range is more than five times that for the automatic additions.

Maintaining the *p*H in the nickel bath is relatively simple with the equipment described. Fig. 8 shows a comparison of *p*H manual with automatic additions taken on twelve consecutive days. With the latter, the *p*H shows only one deviation during this period. With the manual additions of acids daily, the *p*H had a range of 0.5 or nearly ten times greater than the *p*H when using automatic additions. Normal addition by the automatic equipment maintains copper contamination below five milligrams per liter, and iron contamination was below ten milligrams per liter.

V. CONCLUSION

The equipment has been relatively trouble-free. Maintenance has been confined primarily to cleaning electrical contacts on the relays, ampere hour meters and timers.

The automatic addition of chemicals to the nickel plating bath has made it easy to control stress in the metal deposit much closer than was possible previously. The equipment described above has achieved, therefore, the objective of less fluctuation in the physical properties of the electroformed plate by closer control of the plating bath through the control of salt concentration, impurities, *p*H and other factors affecting stress.

Mitchell G. Osman was graduated from Indiana Central College in 1939, receiving a BS degree in chemistry. He was employed by International Harvester Company, Indianapolis, Indiana, in the Metallurgical Laboratory from 1939 to 1945. Since 1945 he has been with the Victor Division, RCA, Indianapolis serving as process engineer in charge of the Factory Control Laboratory. He is a member of the AES, Indianapolis Branch.

A METHOD FOR DETERMINING ABRASION RESISTANCE OF THICK ANODIC COATINGS ON ALUMINUM

by BRUCE E. DEAL*

An abrasive jet apparatus, similar to one designed at the National Bureau of Standards, was used to determine abrasion resistance of anodic coatings on aluminum. Abrasion resistance was determined in terms of the time required for a stream of abrasive particles under controlled conditions to break through the coating. The effects of anodic coating properties (ie, thickness, porosity, hydration, etc) and operating variables of the apparatus (ie, gas pressure, abrasion angle, abrasive flow rate, etc) on abrasion resistance values were determined. From these experiments, optimum operating conditions were established for testing anodic coatings of the thickness range 0.0001 to 0.0050 inches (2.5 to 127.0 microns). The instrument provides an excellent means of comparing abrasion resistance of anodic coatings produced on different alloys with various electrolytes. The method is rapid and simple, and reproducibility of ± 10 per cent can be obtained.

INTRODUCTION

RECENT INVESTIGATIONS in these laboratories have been concerned with the structure and physical properties of anodic coatings on aluminum. Conventional sulfuric acid coatings and the so-called "hardcoats" have been studied. Hardcoating processes[1] differ from common sulfuric acid anodizing in that a denser, less porous and thicker aluminum oxide coating can be produced in a given anodizing time. These properties make hardcoats quite suitable for applications where an abrasion resistant surface on a light metal is required.

Some method of comparing the properties of these special coatings was necessary. Numerous methods have been developed for the measurement of abrasion resistance of anodic coatings on aluminum. Among the techniques reported have been those using microhardness testers,[2] the Taber abraser[3] and a metal knife scratch method.[4] However, the most satisfactory method has been the abrasive impingement technique, first carried out on organic coatings by Schuh and Kern.[5] Edwards[6] and Arlt[7] modified the equipment of Schuh and Kern for use on aluminum anodic coatings. Arlt's work formed the basis for the United States ASTM[8] and British Standard[9] abrasive blast techniques. A related ASTM method is the falling sand test,[10] which is less accurate than the jet abrasive impingement method but simpler and less expensive.

Most of the above tests measure the abrasion resistance of the coating by blasting the surface at a definite angle with a fine abrasive powder** propelled by compressed air under pressure. The abrasion resistance is determined in terms of weight of abrasive used or abrasion time. This method best represents the wear the anodized product will receive in actual service.

Originally, abrasion tests were carried out in these laboratories with the Taber Abraser or the Procelain Enamel Institute Abrasion Tester, both slow, laborious methods of abrasion testing. A more rapid, less complicated process for this type of measurement was needed.

Abrasion testing of organic coatings on metals being carried on at the National Bureau of Standards in Washington, D. C., using an abrasive jet apparatus, had attractive possibilities. Preliminary evaluations of anodic coatings by the Bureau showed a close correlation to data obtained by the PEI tester. A similar jet abrader was constructed and a series of tests carried out to standardize and calibrate the instrument.

DESCRIPTION AND OPERATION OF ABRADER

The design of the jet abrasive instrument used in this work was based on one described by Roberts, Crouse and Pizer at the National Bureau of Standards.[11] The basic plan represents an adaptation of the "Airdent" drilling equipment.*

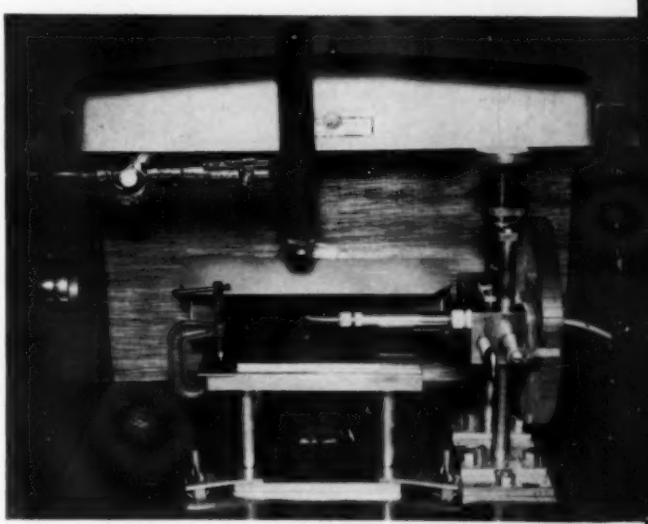

Fig. 1. Abrasive jet apparatus. Not pictured are abrasive chamber and other auxiliary equipment.

*Research Chemist, Finishing Branch, Department of Metallurgical Research, Kaiser Aluminum and Chemical Corporation, Spokane 69, Washington.

**Carborundum No. 180 silicon carbide or Alundum No. 190 aluminum oxide.

*Industrial Division, S. S. White Dental Manufacturing Company, 10 East 40th Street, New York 16, New York.

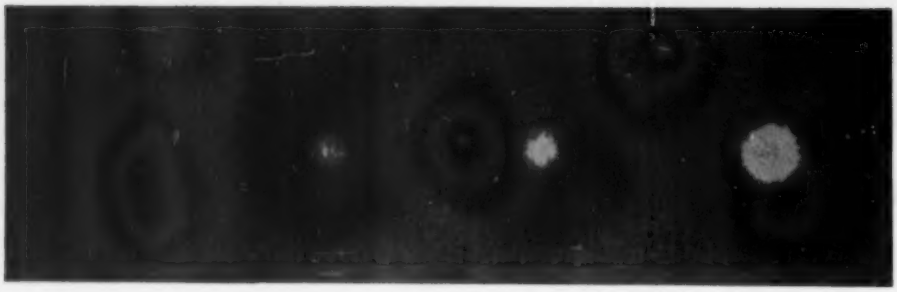

Fig. 2. Typical example of progression (left to right) of jet action on anodic coating. Third from left is considered correct endpoint. 6x

A complete description of the instrument including recent modifications is available in papers by Roberts and co-workers.[11, 12]

Briefly, this method measures abrasion resistance in terms of the time required for a controlled abrasive jet stream to break through the coating to the base metal. Abrasive powder* is propelled from a vibrating storage chamber under controlled gas pressure (after sifting through a row of holes in the bottom of the chamber) and blasts through a right-angle nozzle onto the coating being tested. The "break-through" endpoint is determined visually, and abrasion resistance is expressed in seconds. Usually a minimum of five tests or spots are required for each determination. Specific abrasion resistance is defined as total abrasion time per unit thickness, and in the case of anodic coatings is expressed in seconds per mil (0.001 inch).

Several operating conditions must be specified for the jet abrader, depending on the system being tested. These include gas pressure, abrasion angle (angle of the abrasive jet stream to the surface of the coating), nozzle to coating distance, and hopper sifting hole size. The standardization of the jet abrader for testing anodic coatings involved the determination of the effect of operating conditions upon abrasion resistance values, in order that optimum operating conditions might be selected.

*Aluminum Oxide

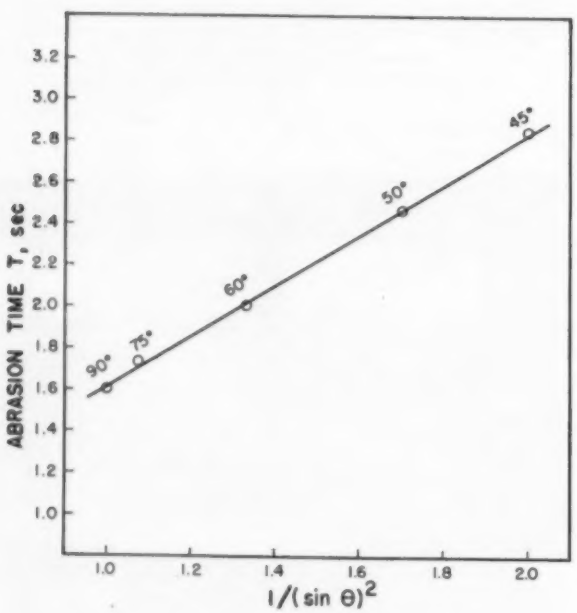

Fig. 3. Relationship between abrasion angle "θ" and abrasion resistance of anodic coating. Coating was a hardcoat on 5005 alloy, having a thickness of 1.60 mils (0.0016 inches). Other abrasion testing conditions were 50 psi CO_2 gas pressure and 0.40 inch nozzle tip to coating distance.

In some cases it was difficult to distinguish between coating and base aluminum (depending on the alloy and anodizing process). The use of a 20 power measuring microscope improved considerably the reproducibility of endpoint determination.

It was found that the most uniform rate of abrasive flow occurred during the first few seconds of abrading. Therefore, the practice was adopted to abrade on a single spot for only four seconds, switch off the abrader, switch it on and abrade for another four seconds, and so on until the endpoint was obtained.* A notable improvement of reproducibility was noted after this cycling procedure was used for thicker coatings.

The jet abrader, which we constructed after the design of Roberts and co-workers, is shown in Fig. 1. Since the photo was taken, a rack and pinion mechanism has been added to the microscope for more rapid focusing on panels of different thicknesses. An example of a typical progression of a "break-through" is shown in Fig. 2. The chief consideration of the operator is to decide what spot diameter will constitute the endpoint.

EFFECT OF OPERATING VARIABLES

Angle of Jet Stream to Coating

Initial experiments on anodic coatings showed that abrasion at a 90° angle resulted in the shortest "break-through" time for a specific sample and that the time increased as the angle was decreased. Roberts[11] found a longer abrasion time at 90° than at 45° but this was undoubtedly due to the resiliency of the organic coatings he tested. With anodic coatings, the main factor determining abrasion time is the vertical energy or velocity component of the jet stream on the surface.

Various angles were tried and an optimum value appeared to be 60°, at 50 pounds per square inch (psi) CO_2 pressure with a nozzle to coating distance of 0.40 inch (1.02 cm). Angles too much greater than 60° resulted in "break-through" times too short to distinguish among coatings of varying thicknesses. On the other hand, abrasion times when abrading was done at angles of 45° or less were not as reproducible as the times at a 60° abrasion angle. The 60° angle allowed an abrasion time of about two seconds per mil (0.001 inch) of coating thickness.

*Optimum operating conditions chosen, as discussed in the next section, result in abrasion times of about two seconds per mil (0.001 inch) of coating thickness. Therefore, for most coatings up to four mils, it is necessary to switch the instrument off and back on only once during a test.

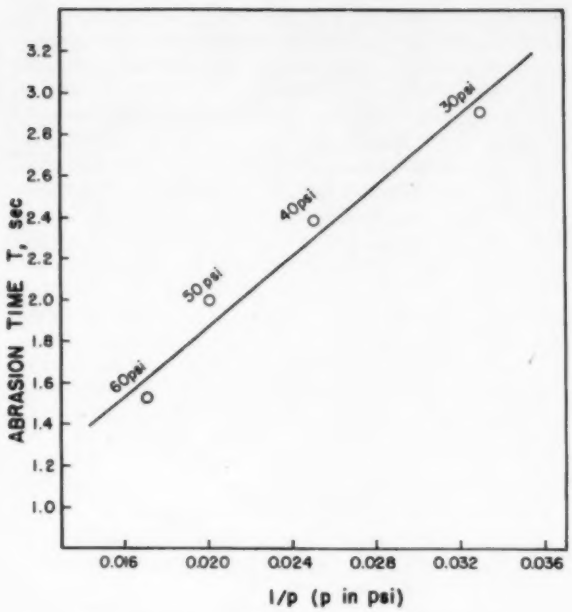

Fig. 4. Relationship between CO_2 gas pressure "P" and abrasion resistance of anodic coating. Coating was a hardcoat on 5005 alloy, having a thickness of 1.60 mils (0.0016 inches). Other abrasion testing conditions were 60° abrasion angle and 0.40 inch nozzle tip to coating distance.

To determine the exact relationship of angle to abrasion time, abrasion experiments were carried out on a standard anodic coating at angles from 45° to 90°. From the equation:

$$t = \frac{k_\theta}{(\text{Sin } \Theta)^n}$$

where: t = abrasion time per spot in seconds
k_θ = a constant
Θ = jet stream-coating angle
n = a constant,

k_θ was determined for various values of n. Sin Θ was used since it is the factor required to calculate the vertical, downward component of the total energy of particles striking against the coating surface (See Appendix A). A plot of abrasion time against $\frac{1}{(\text{Sin } \Theta)^2}$ (Fig. 3) indicates that k_θ is constant for $n = 2$.

CO_2 Gas Pressure

The effect of gas (CO_2) pressure on abrasion time was similar to that found by Roberts.[11] A gage pressure of 50 psi CO_2 resulted in the most reproducible data for anodic coating testing.

From the equation:

$$t = \frac{k_p}{P^n}$$

where: t = abrasion time per spot in seconds
k_p = a constant
P = CO_2 pressure in psi
n = a constant

for CO_2 pressure of 30 to 60 psi, k_p was found to be constant when $n = 1$. Fig. 4 shows this relationship, where k_p is represented by the slope.

Nozzle to Coating Distance

In agreement with Roberts' findings for organic coatings, a distance of 0.40 inch from the nozzle tip to the sample (0.60 inch from the nozzle housing) was satisfactory for anodic coatings. A 0.10 inch change in nozzle to coating distance, caused a corresponding change of abrasion time of 0.70 sec/spot in 2.0 seconds total abrasion time. If reproducibility of ± 0.1 sec/spot was to be obtained in 2.0 secondstotal time (± 5.0 per cent), up to 0.015 inch variation in nozzle to coating distance could be allowed. There was no difficulty in controlling the distance within this tolerance.

The equation:

$$t = k_d f(d)$$

where: t = abrasion time per spot in seconds
k_d = a constant
$f(d)$ = some function of nozzle to coating distance

was used to compare several functions of distance. It was not known whether distance should be measured from the tip (d) or from the housing (d + 0.2). Results indicated that $(d + 0.2)^2$ provides the most constant relationship, with $(d)^2$ and (d) next best. Roberts obtained the (d) dependence[11] and attributed it to the direct relationship between (d) and the diameter of the abraded area. This might be the case, but it is likewise true that $(d)^2$[or $(d + 0.2)^2$] is proportional to the abraded area itself. A plot of abrasion time versus $(d + 0.2)^2$ is presented in Fig. 5. A possible explanation supporting the dependence of abrasion time on some function of $(d)^2$ is given in Appendix A.

Construction of Abrasive Chamber

Abrasive flow rate was dependent on the size of the holes in the storage chamber through which the abrasive sifted. Hole size could be varied by changing a removable plate. The first tests used holes 0.0135 inch in diameter. However, these failed to give satisfactory results and the holes were

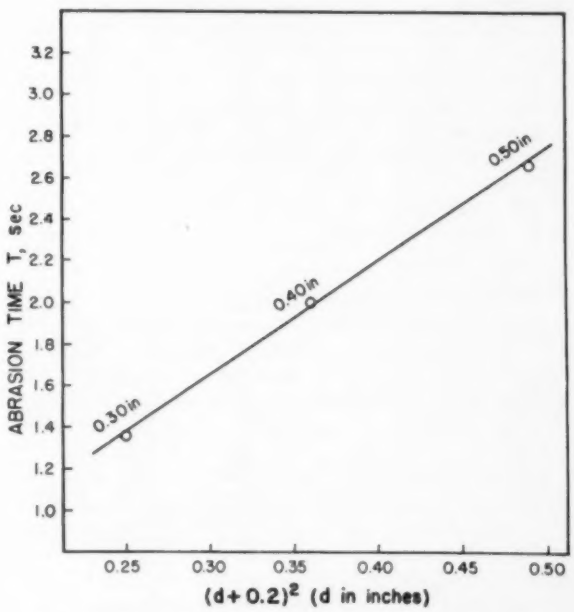

Fig. 5. Relationship between nozzle tip to coating distance "d" and abrasion resistance of anodic coating. Coating was a hardcoat on 5005 alloy, having a thickness of 1.60 mils (0.0016 inches). Other abrasion testing conditions were 60° abrasion angle and 50 psi CO_2 pressure.

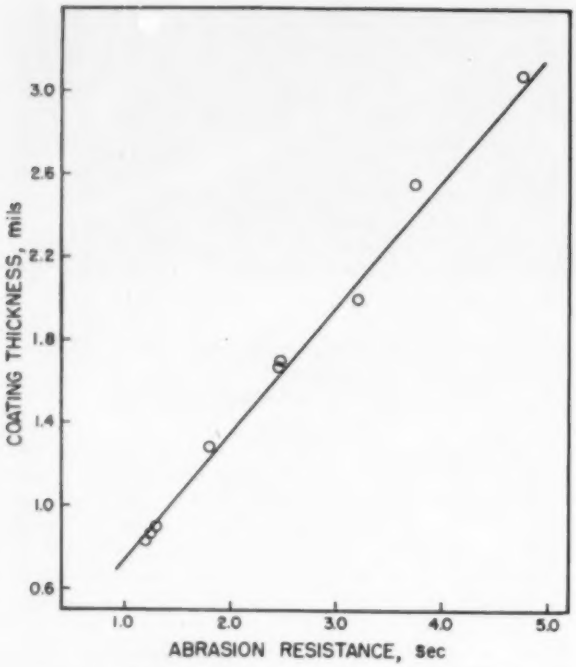

Fig. 6. Relationship between abrasion resistance and anodic coating thickness. Coatings are hardcoats on 1100 alloy.

increased to a 0.0200 inch diameter size. These allowed an abrasive flow at 50 psi CO_2 of 8–12 g/min, measured in approximately 4-second intervals. Results using this size of sifting holes were such an improvement that no further attempts were made to change the hole size.

Roberts reported[12] that the level of abrasive in the storage chamber had marked influence on abrasion time. This effect was verified by our experiments. Attempts were made to obtain a definite relationship between abrasive level and abrasion resistance, but results were too erratic. Generally, if a coating exhibited a specific abrasion resistance of 1.25 with a full hopper, the value would increase to 2.00 or more as the abrasive level dropped to one-half the original. For this reason, following Roberts' procedure, a standard coating was introduced for calibration purposes. Thus any errors in abrasion time caused by abrasive level variations or other factors could be corrected.

Anodic Coating Properties

Several properties of aluminum anodic coatings influence total or specific abrasion resistance. These include thickness, apparent density or porosity, nature of seal, degree of hydration and chemical composition (i.e., 13 per cent SO_3 from sulfuric electrolyte, 3 per cent $(COOH)_2$ from oxalic electrolyte, etc.).

Coating thickness, of course, affects total abrasion resistance and is used directly in calculating specific abrasion resistance. Figure 6 shows a direct linear relationship between total abrasion resistance and coating thickness, in the range 0–3 mils, for one particular alloy, 1100. These values are for a series of hardcoats anodized for various times.

The porous structure of an anodic coating undoubtedly determines to a large extent its abrasion resistance. Specific abrasion resistances and apparent coating densities are plotted in Fig. 7 for a number of anodic coatings—both conventional and hardcoats, and representing several alloys. The good straight-line relationship demonstrates that abrasion resistance is directly proportional to apparent coating density.

The sealing process, the humidity, and the length of time since preparation influence abrasion resistance of anodic coatings.[7, 13, 14] Experiments have shown the abrasion resistance of sealed hardcoats to drop to 50–70 per cent of the unsealed value (below 50 per cent in the case of 2024 alloy). It is for this reason that hardcoats are not normally sealed. Lesser effects have been noted due to atmospheric humidity variations. An aged coating will have a lower abrasion resistance than when freshly prepared. These effects are believed to be caused by the formation of a hydrated aluminum oxide, which is less resistant to abrasion than is anhydrous Al_2O_3. The anodizing conditions and the type of electrolyte in which the anodic coating was produced will naturally result in some difference in coating structure and composition, and therefore, in abrasion resistance.

CONCLUSIONS

A relationship between coating abrasion resistance and several operating variables can be expressed by the equation:

$$t = \frac{K\, y\, \rho\, d^2\, f(L, R)}{P\, (\sin \theta)^2}$$

where: t = abrasion time per spot
y = coating thickness
ρ = apparent coating density
d = nozzle to coating distance
P = CO_2 pressure
θ = jet stream – coating angle
$f(L, R)$ = function of abrasive level L in hopper and abrasive flow rate R from hopper
K = a constant which includes such factors as degree of hydration, type of coating, etc.

A non-linearity constant might be added to the equation, although this factor was found to be unimportant when abrading in four second intervals. It can be seen that there are three major influences upon abrasion time:

(1) nature of coating—y, ρ
(2) hopper conditions—f(L, R), and
(3) other operating conditions—d, P, θ.

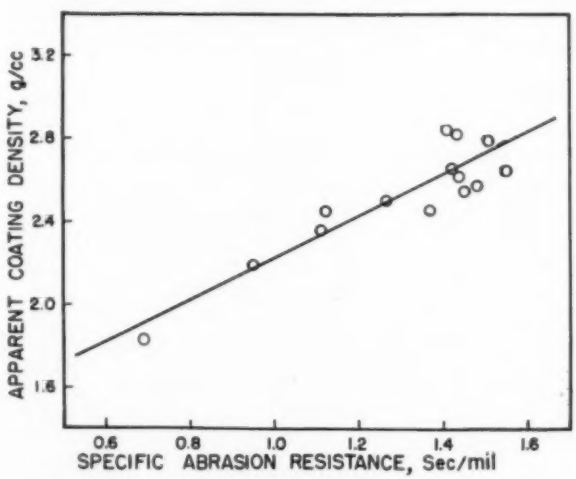

Fig. 7. Relationship between specific abrasion resistance and apparent anodic coating density. Coatings represent several alloys and both conventional and hardcoats.

ELECTROPLATED ELECTRICAL CONNECTIONS AND

Theoretical considerations of some of these abrasion variables are presented in Appendix A.

Optimum conditions for determining abrasion resistance of anodic coatings by the jet abrader were found to be:

Angle of jet stream to coating surface . . . . . 60°
CO_2 gas pressure . . . . . 50 psi
Nozzle tip to coating distance . . . . . 0.40 inch
Use standard anodic coating to calibrate abrader (standard kept in desiccator when not in use).
Abrade on any one spot in 4-second intervals.
Use measuring microscope (~20 power) for endpoint determination.

If the above conditions are followed, the jet abrader can be quite useful in determining abrasion resistance of anodic coatings—"hardcoats" in particular. It is a rapid and accurate method of comparing coatings on different alloys, those produced by different processes, or those produced using different process conditions. The instrument is quite versatile; flat, round or irregularly shaped objects can be tested. Reproducibility of results has been found in these experiments to be about ±5 per cent.

It would be impossible to correlate directly the results obtained by use of this instrument with the performance of anodic coatings in each of the countless number of applications in which they are used, but its simplicity and rapidity of operation make it a valuable tool in evaluating anodic coatings. The main improvement which might be made on the instrument would be the construction of an abrasive storage chamber capable of producing a uniform rate of flow during operating periods from one second to infinity. This would eliminate the need of abrading in 4-second intervals, as well as the frequent calibrations required due to abrasive level change. Also, it would allow direct comparisons from one jet abrader to another without extensive standardization.

ACKNOWLEDGEMENTS

Mr. A. G. Roberts of the National Bureau of Standards generously gave information concerning improvements in his jet abrasive apparatus, in advance of his own publication. Messrs. S. C. Jones, R. V. Paulson and L. Swanson of this laboratory also contributed effort and ideas during the course of this work.

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APPENDIX A

The inverse relationships, as found in this work, of $(\text{Sin } \Theta)^2$ and P with abrasion time can be understood from a consideration of the forces involved when abrasive particles strike the coating surface. The abrasion time is inversely proportional to kinetic energy of the jet stream:

$$t = \frac{k_1}{K.E.}$$

where: t = abrasion time
k_1 = constant

We know that kinetic energy is proportional to mv^2, where m = mass of the material and v is its velocity. Therefore:

$$t = \frac{k_2}{mv^2}$$

But if the abrasive stream is at an angle, only a vertical component is actually involved in the abrasion action. Thus:

$$v^2 = \bar{v}^2 (\text{Sin } \Theta)^2$$

where: v = vertical component of gas velocity
$\bar{v}$ = overall gas velocity
Θ = angle of jet stream to coating surface

Hence:

$$t = \frac{k_2}{m\bar{v}^2 (\text{Sin } \Theta)^2}$$

But we also know from Bernoulli's equation for flow through a tube that pressure drop is proportional to $m\bar{v}^2$. Therefore:

$$t = \frac{k_3}{P(\text{Sin } \Theta)^2}$$

which represents the relationship found experimentally among abrasion time, CO_2 pressure and abrasion angle (Figures 3 and 4).

Supporting evidence for the relationships found experimentally between abrasion time t and coating thickness y, coating density ρ, and nozzle to coating distance d follows. The relationship found was:

$$t = k_4 \rho y d^2$$

Abrasion area A is proportional to the square of nozzle to coating distance d so we can further state that:

$$t = k_5 \rho y A$$

But the product of density, thickness, and area is equal to weight or mass. Therefore:

$$t = k_5 M$$

Thus total abrasion resistance is therefore proportional to the mass of Al_2O_3 which is removed by the action of the abrasive jet stream. This dependence is logical and helps corroborate the experimental findings.

Dr. Bruce E. Deal received an AB degree from Nebraska Wesleyan University in 1950, and the MS and PhD with a major in physical chemistry from Iowa State College in 1953 and 1955 respectively. While attending Iowa State, he was employed by the Ames Laboratory of the AEC as a research assistant. He joined Kaiser Aluminum and Chemical Corporation's department of metallurgical research in 1955, where he has worked since as a research chemist. Principle areas of research have included surface chemistry of solids, electrochemistry and in particular, anodizing of aluminum.

Dr. Deal is a member of the American Chemical Society, the Electrochemical Society, the American Association for the Advancement of Science, the Electron Microscope Society and Sigma Xi as well as other honorary societies.

ELECTROPLATED ELECTRICAL CONNECTIONS AND IMPROVED THROUGH HOLE PRINTED WIRING*

by EDWARD B. MURPHY**

Utilizing a temporary copper oxide film on a metal imbedment or conductor strip, excellent bonds can be realized between a deposited printed wiring strip on a dielectric material and the metal imbedment or conductor.

A REQUIREMENT FOR AN ELECTROPLATED CONNECTION for an encapsulated module containing a number of electronic components arose recently. These components were mounted vertically in a cube of dielectric material. The copper component leads appeared in a prescribed location on two surfaces. (Figs. 1 and 2)

Repeated efforts to use the standard procedure to produce a printed wiring circuit on the dielectric surface through which the leads passed would not suffice. Although a good bond resulted between the chemically-reduced metal film and the dielectric surface, a non-adherent scum developed on the copper lead surface of the imbedded wire or, at best, a poorly adherent product was produced.

It appeared necessary to change the character of the copper lead surface to overcome this poor bonding phenomenon. Electroplating techniques at this stage would be difficult because of the isolated state of each lead. Several immersion processes were considered, such as, electroless nickel, immersion gold and tin. In the presence of the protecting film provided by these processes, the subsequent chemically-deposited conducting film for metallizing the dielectric adhered to the treated copper lead without scumming. On testing, however, the bond was peelable and had a value of 3–5 lb/in wide peel.

The next coating technique was to oxidize the copper leads to black cupric oxide. The oxidation was performed by using an alkaline chlorite oxidizing salt preparation.† By following the prescribed techniques for chemically-depositing copper onto a dielectric††, no scumming was evident, and a practically unpeelable bond between the copper lead and the printed wiring conductor resulted. This printed wiring conductor is obtained by electroplating 1–2 mils of copper from an acid copper plating solution and then the conductor is produced by standard photo-resist etching techniques.

What we attempt to test is the type of bond between this conductor and the metallic imbedment, i.e., the component lead. The results have been impressive. The weakest bond, and the only one peelable, was calculated to be 600 lb/in wide peel. All other specimens were unpeelable. The test procedure used was a modified Jacquet method, as described by Linford and Venkateswarlu.[2] These gentlemen used the test to determine the effect of copper oxide on the bond strength of a nickel deposit. Essentially, it consisted of electroplating a 60 mil thick tab 5 mm wide and peeling. The test specimen was 50 by 30 mm; twenty mm of one end received a graphitic coating so that the peel could be started. It was this tab that was gripped in the Tinius Olsen tensile tester and a graduated load applied. Additionally, tensile tests have been made and indicate bonds superior to soft solder. Copper rods with a diameter of $^3/_{16}$ in. were treated with oxidizing salts, metallized and electroplated. Their ends were soft-soldered together. A tensile load was applied and all specimens broke at the solder interface (approximately 5000 psi). (Fig. 3)

The stoichiometry involved is an oxidation and reduction phenomenon. The cupric oxide on the copper lead surface is thoroughly reduced to the metal by two reducing agents. One reducing reaction occurs in an acid solution of stannous chloride, which is a sensitizer for depositing metal (metallizing) onto dielectric materials. The further reduction takes place in an alkaline copper-sulfate formaldehyde solution.

When the test specimen is to be metallized, it is immersed in the sensitizer solution and a two-fold function takes place. Stannous ions (Sn^{++}) are adsorbed onto the surface of the dielectric, and the mild reducing agent, stannous chloride ($SnCl_2$), reduces the cupric oxide. The electrochemical values, i.e., the standard state oxidation potentials and the free energy, indicate that the reduction of the cupric ion to copper metal is the most favorable reaction. The stannous ion is oxidized to stannic. X-ray diffraction measurements and color changes from the processing steps indicate the presence of some cuprous compounds, such as the chloride and oxide,

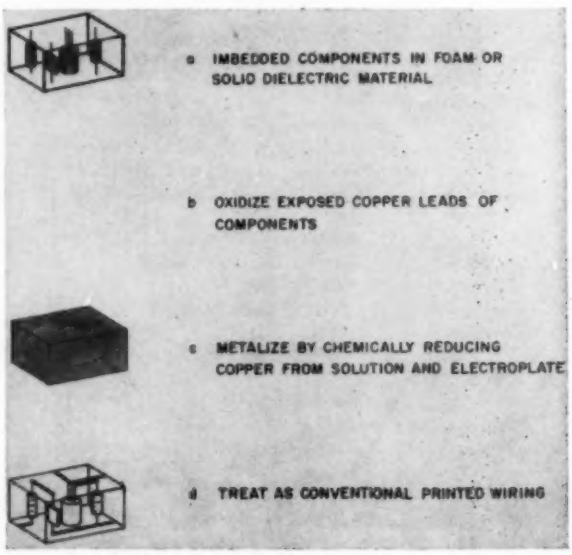
a IMBEDDED COMPONENTS IN FOAM OR SOLID DIELECTRIC MATERIAL
b OXIDIZE EXPOSED COPPER LEADS OF COMPONENTS
c METALIZE BY CHEMICALLY REDUCING COPPER FROM SOLUTION AND ELECTROPLATE
d TREAT AS CONVENTIONAL PRINTED WIRING

Fig. 1. Electroplated electrical connection

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* The work reported here was performed at Lincoln Laboratory, a technical center operated by Massachusetts Institute of Technology with the joint support of the Army, Navy and Air Force, under contract.

** Staff Member, Massachusetts Institute of Technology, Lincoln Laboratory, Lexington, Massachusetts.

† Ebonol C, manufactured by Enthone, Inc., New Haven, Conn.

†† Shipley Chemical Co., Wellesley, Mass.

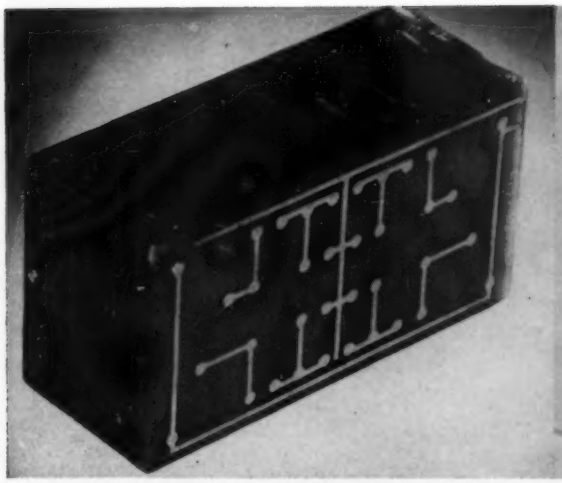

Fig. 2. Printed wiring with plated connections

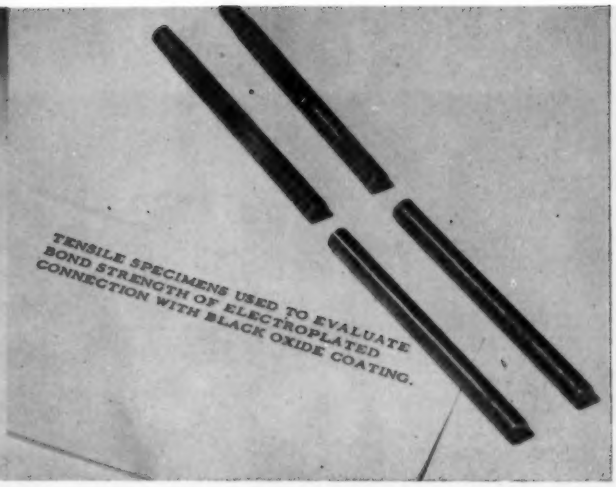

Fig. 3. Tensile specimens

after the stannous chloride step. This reaction is verified by Latimer in the following data:

$$Cu + Cu^{++} = 2Cu^{+} \qquad K = 1.0 \times 10^{-6}$$

and it is stated that in the presence of ions or molecules that form stable complex ions with cuprous, this equilibrium is shifted far to the right. After the treatment with stannous chloride sensitizer, the specimen is immersed in an activating solution, dilute palladium or gold chloride solution (1 g/l). Palladium or gold ions are reduced to metal in the pores of the dielectric by the stannous ions and act as a catalyst in the following solution reduction of copper.

As to the reaction that takes place in the actual metallizing solution, the following seems probable, as indicated by Latimer:[3]

	Standard Potential E°
$Cu^{++} + 2e \overset{\text{alkaline}}{=\!=\!=} Cu$	−0.224
$HCHO \overset{\text{alkaline}}{=\!=\!=} HCOO^{-}$	1.14

The free energy for this overall reaction calculates over 60 K cal and indicates a spontaneous or natural tendency to occur as written. It is interesting to note that the oxidation potential for formaldehyde in an acid medium is only one hundredth (1/100) the value in the alkaline medium. In the above reaction, the cupric ion is chelated to prevent its precipitation as a hydroxide in the alkaline medium. The metallizing reaction is essentially a Fehlings-type reaction used in organic chemistry as a qualitative test for the presence of the aldehyde group.[4]

The excellence of the bond is attributed to the co-reaction of the two reduced copper nuclei; one from the oxide and the other from solution. This co-reduction brings about an intimacy that yields both a chemical as well as mechanical bond. (Fig. 4)

Applying this oxide coppering technique to more conventional printed wiring practices, an improved through-hole printed wiring product can be realized. The advantages will be evident from the following outline of steps and the schematic, Fig. 5.

1. Pre-punch a 1-oz copper-clad laminate with the required hole pattern.
2. Oxidize the copper-clad surfaces.
3. Metallize the ID of the "through hole" with the sensitizer, activator and reducer solutions.
4. Electroplate with acid copper both the clad surface as well as the metallized "through hole" areas. A deposit of about 1 mil will bring the 1-oz copper clad to a 2-oz copper thickness. These deposits will act as an integral foil, both on the surface as well as through the holes.
5. Silk screen, or apply a photo sensitive acid resist, and solder electroplate the desired circuitry.
6. Etch in chromic acid, or its equivalent.

There are modifications of these steps, but the significant feature is incorporated—the chemically deposited copper becomes an integral part of the initial copper clad. An obvious alternative to the above sequence is to apply the resist immediately after chemical metallizing. (Switch Step 4 with Step 5.) A copper flash can suffice and solder electroplate used directly. Patently, this will cut down etching time.

Three outstanding points are:

1) There is no interruption of conductor from the copper-clad surface to the electroplate in the ID of the hole.
2) There is no abrasive cleaning necessary to remove the undesirable by-products of the copper metallizing step. Usually, if the oxide is not included, the copper-on-copper is poorly adherent and, at best, must be removed. This is especially true when a dip soldering treatment is to be included and where the heat can cause blistering.
3) It is not inconsistent to consider that the clad laminate suppliers could supply a preoxidized foil. Some people have used the oxide on the adherent side to improve their dielectric to copper foil bond because of the polar nature of the copper oxide which improves adhesion.

With additional experiments it may be possible to work the oxidizing treatment in with one of the pre-dip solutions. There are, no doubt, other and, perhaps, superior oxidants that should be evaluated. Blending with the predips appears to be the next most logical step.

In addition to these two applications discussed here, it is planned to utilize this bonding technique for interconnection between miniature components as well as modules. Miniaturization soldering iron techniques are usually too cumbersome. Two advantages which should be noted are:

1) This bond can take place without any significant heating. Temperature sensitive components can be joined readily.
2) The bond appears to be unaffected by temperatures up to 400F. (The highest tested in this case.)

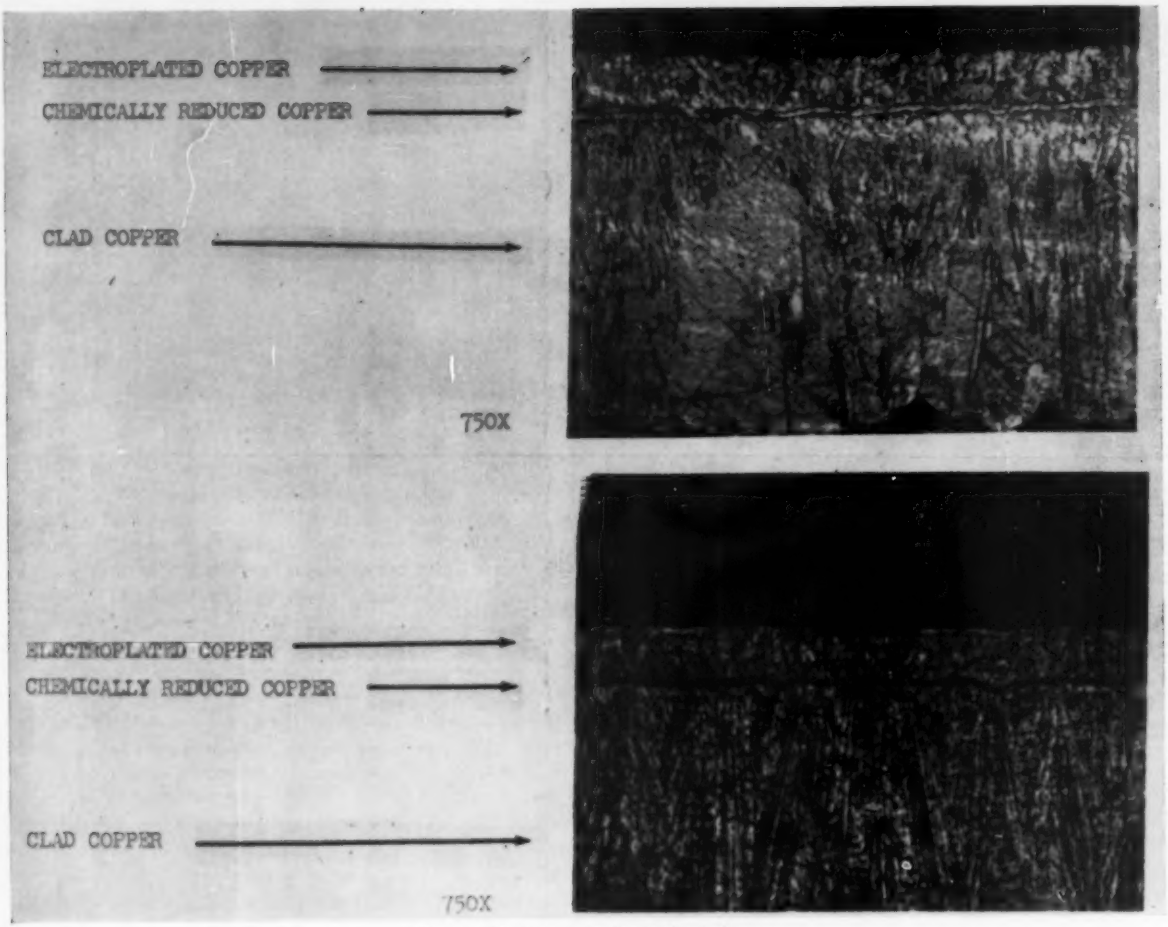

Fig. 4. Photomicrograph of Blend Area

ACKNOWLEDGEMENTS

The author expresses his appreciation to those people who critically reviewed this paper, to William O'Neil—a summer graduate student who performed most of the experiments involved; and he wishes to note that E. A. Guditz originally suggested the feasibility of a plated connection.

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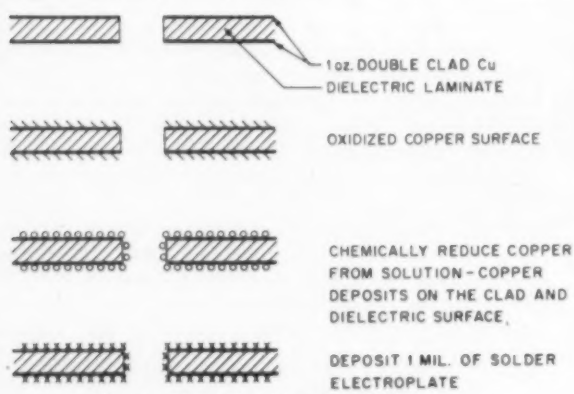
1 oz. DOUBLE CLAD Cu
DIELECTRIC LAMINATE
OXIDIZED COPPER SURFACE
CHEMICALLY REDUCE COPPER FROM SOLUTION - COPPER DEPOSITS ON THE CLAD AND DIELECTRIC SURFACE.
DEPOSIT 1 MIL. OF SOLDER ELECTROPLATE

Fig. 5. Plated Thru-Hole Printed Circuitry

Edward B. Murphy, received a BS in chemistry at Boston College in 1949 and with an assistantship completed the requirements for the MS degree in chemistry in 1951 at Boston College Graduate School. Initially he was employed at the Watertown Arsenal as a metallurgical chemist. Following that he worked at the Missile Division of Raytheon for two years, involved with material and processing problems. For one year prior to his present position he worked as superintendent of an electroplating job shop. In 1954 and to the present he has been with the Massachusetts Institute of Technology Lincoln Laboratory in the development group of the Engineering Division. Problems and activities have ranged through printed wiring, printed circuitry and microminiaturization, terrestrial radomes, and electroforming. The father of six children, he is a member of the American Chemical Society, Society of Plastic Engineers (a session moderator on Printed Circuits at the recent Annual Technical Sessions of the SPE in New York City, 1959), and 40 C Committee of the EIA. He is chairman of the Boston College Alumni Chemical Society.

AES RESEARCH PROJECT NO. 13

THE NATURE, CAUSE AND EFFECT OF THE POROSITY IN ELECTRODEPOSITS

III. MICROSCOPIC DETECTION OF POROSITY

by FIELDING OGBURN and D. W. ERNST *

A new technique called "parallel sectioning" was used for investigating the porosity of nickel electrodeposits. Some of the coating is polished off in a layer parallel to the basis metal. After taking a photomicrograph of this area, another layer of metal is removed. This procedure is continued until the basis metal has been reached. It is possible to construct a three-dimensional model of the coating. Various pore types are listed and illustrative photomicrographs are given.

INTRODUCTION

THE DETECTION OF POROSITY in plated coatings has received a good deal of attention. Thon and Addison,[1] Project 6 of the American Electroplaters' Society, published a critical review of the literature on the porosity of plated coatings. Much of their review deals with the detection of porosity. Subsequently, Thon[2] introduced techniques for measuring the gas permeability of detached coatings; Ogburn and Benderly[3] described a method of photographing pores in detached foils; and Ogburn and Hilkert[4] and Wolff, Henderson, and Eisler[5] used radiographic techniques.

The detection of pores with the microscope seems to have received very little attention. The general attitude of most people in the field, including the authors, is illustrated by a quotation[6]: "In hundreds of metallographic cross-sections of nickel deposits examined over a course of years at magnifications from 100 to 500 diameters not one pore had been encountered which could be recognized as such, . . . " The reason for this failure is not hard to understand. Most pores in nickel deposits have diameters of less than 0.001 inch. The chances of sectioning such a small tube parallel to its axis must be very slight. If it is not sectioned parallel to its axis, only a dot or oval would be seen. Even if it is sectioned properly, there is the added possibility that the contours will be distorted by polishing and etching.

In the past we have looked for a pore cut parallel to its axis and have always failed. A section perpendicular to the axis of the pore, parallel to the basis metal, would be much more likely to cut a pore. A series of such cuts through one specimen should allow one to follow a pore from top to bottom. This approach was tried and led to some interesting observations.

PARALLEL SECTIONING

The coating is polished parallel to the basis metal and a pore then appears as a small dot. It can easily be seen at 400x magnification if it is larger than 0.05 mil (1.2μ) in diam-

* Chemistry Division, National Bureau of Standards, Washington, D. C., Project Director and Research Associate respectively of AES Research Project No. 13.

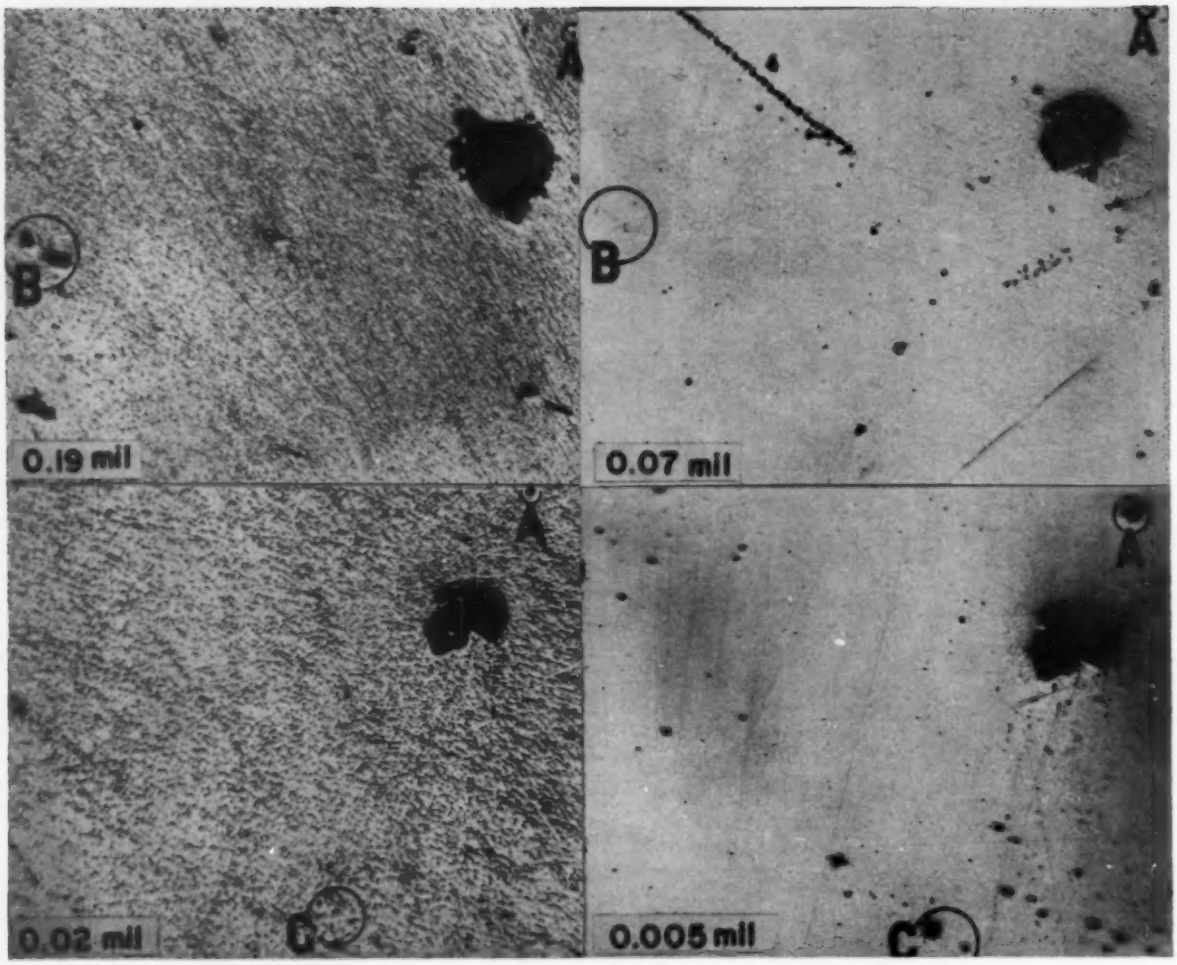

Fig. 1. (400 X) Photomicrographs obtained by parallel sectioning of a nickel deposit. Three types of "pores" can be seen: continuous (A), dead end (B), and bridged (C). A is small (0.08 mil) near the surface becoming larger (0.3 mil) as the basis metal is approached. B extends approximately ⅔ of the way into the deposit. C starts at the basis metal and extends up into the deposit. The deposit was plated on shim steel and was 0.26 mil thick. The number in the lower left-hand corner represents the thickness of the deposit.

eter. It is possible to confuse a pore, seen as a dot, with surface defects introduced during the polishing operation. This difficulty is minimized by polishing away another layer of metal and re-examining the area. The dot, if it is a pore, will appear at the same location. If a dot appears in two or more successive parallel sections, it can be considered to be a real discontinuity in the coating. Fig. 1 is a series of photomicrographs taken of the same area at four stages during parallel sectioning of a Watts nickel deposit.

TECHNIQUES FOR PARALLEL SECTIONING

Mounting foils or thin flat specimens for parallel sectioning requires a technique somewhat different than for cross sectioning. A method of anchoring the thinner specimens in the mounting material is needed to prevent its being dislodged during the polishing operation. Gluing or soldering the specimen to a larger piece of metal before mounting is satisfactory. Attached coatings may be studied by electrodepositing the coating directly on the head of a bolt and mounting the entire bolt. Mounting material was either "Lucite" or "Bakelite".

Levigated Alumina was used to polish the coating. Occasionally it was advantageous to precede the polishing with 600 grit silicon carbide. The polished surface was etched to remove disturbed metal and to bring out any possible structure that may be present. A number of etchants were tried, but Carapellas reagent* was found to be the most satisfactory. It was determined that pits introduced into the sample during the polishing operation can be eliminated to a large extent by controlling the polishing procedure.

To follow pores by parallel sectioning, it is necessary to locate the same area on each successive section. One method is to inscribe reference lines on the specimen but since these are at least partially removed during the polishing operation, a pantograph attachment was found to be more convenient. It was mounted on a stationary platform which encircled the moving stage of the metallograph. The main swivel point was located on this platform, and the second swivel point was located on the metallograph's moving stage. The third point extended over the stationary platform and consisted of a pin

* Ferric chloride 5 gm., conc. HCl 2 ml, Ethyl alcohol 98 ml

which was used to make an indentation on a piece of graph paper. Movement of the stage caused a threefold displacement of the pin. The specimen was held on the stage in a fixed position and could be returned to this position after each polishing step. By placing the pantograph pin back on the original spot, quick and positive location of an area was assured.

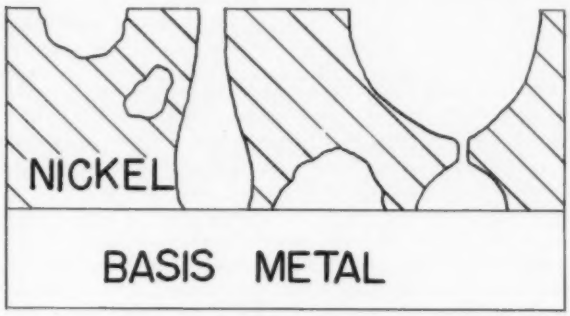

Fig. 2. Schematic diagram illustrating various pore types. From left to right: dead-end pore, void, continuous pore, bridged pore, and a combination of a bridged and dead-end pore connected by a small channel.

TYPES OF PORES

The parallel sectioning technique was first used with nickel foils to follow pores that were identified by their ability to transmit light. The method was then used to examine nickel and nickel-chromium coatings on steel.

The types of pores or defects found in the Watts nickel coatings are pits (dead-end pores), cavities (enclosed pores), continuous pores, and bridged pores. Fig. 2 is a schematic diagram of the various pore types. Three of the types can be seen in Fig. 1. At the upper right, (A) is a continuous pore which has a diameter of 0.08 mil (2μ) at the surface and 0.3 mil (7.5μ) near the basis metal. Located at the middle far left (B) is a group of pits which were started in the upper third of the deposit. Two bridged pores may be seen in the lower center at (C).

Since our observations were rather limited, little can be said about the relative frequency of each type of pore; however, because each of the four types was found with very little effort it would appear that they are about equally prevalent.

CONCLUSIONS

The method of successive parallel sectioning offers a new means of examining metallic coatings. With it one can determine the size and shape of pores or other defects that are difficult to cross section. It should also be useful for investigating the damage done to coatings by atmospheric corrosion.

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Fielding Ogburn received a BS degree in 1941 from the University of Chicago, and is the assistant chief, Electrodeposition Section of the National Bureau of Standards. Mr. Ogburn is a member of the ACS; ASTM, serving as chairman, Subcommittee 1, Committee B-8; past chairman, Washington-Baltimore Section, Electrochemical Society. He is a Delegate and has served as Alternate Delegate, Secretary, Librarian and President of the Baltimore-Washington Branch, AES. Mr. Ogburn is Project Director of AES Research Project 13.

Donald W. Ernst received a PhD in inorganic chemistry and physical metallurgy from the University of Wisconsin in 1956, and since that time has been research associate for Project 13 at the National Bureau of Standards. Dr. Ernst is a member of AES, ACS, ASM, The Electrochemical Society, Phi Lambda Upsilon, and Sigma Xi.

LEAD ANODES FOR CHROMIUM PLATING

by HENRY R. FRIEDBERG*

THROUGH THE YEARS, many attempts have been made to improve the efficiency and boost the throwing power of anodes in chromic acid plating baths. Attention has centered principally around development of new shapes. Formerly, rectangular anodes with multiple edges, such as sawtooth and ribbed configurations, were extensively used. Recently, round anodes have come into widespread use. Theoretically, it had been felt that rectangular anodes have the disadvantage of an inactive backside, whereas, in contrast, a round anode has a surface which is active around the entire circumference. It would appear that a round anode with a 100 per cent active surface would require less tank voltage to carry a given current through the bath than an anode with dead spots and chromate film build-up. Conversely, it would appear that higher currents could be used without undue heat-up in a round anode.

In spite of considerable discussion, however, there has long been a general lack of scientifically-obtained data about this and other factors affecting the properties of lead anodes. Because of this, an investigation was conducted under controlled laboratory conditions. The results are set forth below.

CONDUCTIVITY

The lead anode must carry the current into the chromium plating bath. Lead is a poor conductor; taking the conductivity of electrolytic copper as 100, cast copper has a conductivity of 45–50 (depending on impurities) and lead has a conductivity of only 7.71. These relative figures must be considered in the construction of anodes, as we will show.

HOOKS

Contact between the anode and the bus bar is usually made through a copper hook. The difference in conductivity between copper and lead, and the manufacturing process used to attach the hook to the anode proper, are principal causes for many of the problems found in some types of anodes.

Most anodes are produced by dipping the lower portion of the cast copper hook into lead alloy to give it a lead coating. It is then placed in a mold and lead is cast around the "tinned" portion. This assembly is then burned to the anode. Certain difficulties are inherent in anodes produced in this manner.

Between the time that the hook is dipped into lead alloy and its being placed in the mold, the lead-coated hook will cool and its surface will oxidize, weakening the subsequent bond with cast lead. Difficulty arises from the difference in conductivity between the cast copper hook, the relatively porous cast lead and the high density extruded lead which makes up the anode proper. As current travels through the hook and cast lead into the anode, resistance builds up which leads to heating. The copper expands, along with the cast lead. However, upon cooling, the copper will contract but the lead, having a weak bond, may not. Thus, a small gap is formed, allowing oxidation to take place. On anodes of this type the extruded portion is usually joined to the cast lead at the solution level. Consequently, there is a point of high resistance at this point. Fig. 1 is a photograph of the cross section of a cast-lead-over-copper-hook of an anode after use. The poor adhesion of lead to copper and general void areas are clearly shown.

Fig. 2 is a photograph of the cross section of a hook homogeneously burned into the extruded lead anode using a flux especially developed for this purpose. The homogeneous lead burned over the hook has the same density as the extruded lead. It will be noted in the photograph that there is a perfect bond between copper and lead; no gaps or voids are evident. This particular section was cut from an anode which had been in use more than two years.

SURFACE FILM

A brown film of lead peroxide (PbO_2) will form on the surface of a good anode which has been properly prepared before use. This film is important because it furthers reoxidation of the trivalent chromium in the bath. However, if there are areas on the anode which are inactive or dead, a yellow film of lead chromate ($PbCrO_4$) is formed. This film must be removed to restore the anode to active service.

SHAPE

Tests were conducted to determine the differences, if any, between round anodes and rectangular anodes having multiple edges. In these tests, six hollow round lead anodes, 2 in. in diameter, were placed in an experimental plating tank, three on each side of the cathode. A polished steel panel, which had previously been nickel plated, was held in a panel rack and served as the cathode. The total tank current was adjusted to 450 amperes and the voltage necessary to maintain this current was recorded throughout the 90-minute plating period.

The detailed test conditions are shown in Fig. 3; the curves resulting when the voltages were plotted are shown in Fig. 4.

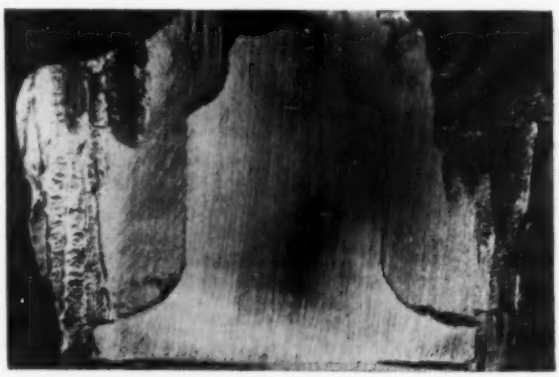


Fig. 1. Cast lead over copper hook. 2½X

* Technical Director, The Frank L. Crobaugh Company, Cleveland, Ohio.

It will be noted approximately 6 per cent more voltage was required to maintain the chosen amperage with the flat anodes than with the round, despite the fact that the flat anodes contained 7 per cent more area and thus should have required a lower potential.

These data were of necessity obtained over a relatively short test period, and new anodes were used for each test. If such a test were to be conducted over a long period of time and under simulated production conditions, where the anodes are alternately in active use and idle in the tank, film build-up would occur on the inactive backsides of the flat anodes, reducing the effective area and, it can be assumed, increasing the voltage difference between the two types of anodes.

Because the round anode has a 100 per cent active surface there is less chance of building up undesirable films which would result in increased resistance. Thus, higher currents can be used without undue heating. A round anode with a homogeneously burned-in hook would represent the desirable type.

ROUND ANODES: HOLLOW vs SOLID

As plating installations get larger and the length of anodes used increases (notably as in some of the automotive plants), weight of the lead anode becomes an important factor. As a result, a trend towards the use of hollow round anodes has developed. With a 1½ in. diameter hollow round anode, the savings in weight amounts to about 25 per cent over a round solid anode of the same dimensions. With a 2 in. diameter anode, the reduction in weight is around 40 per cent. Thus, not only is handling facilitated, but shipping costs are reduced.

However, the question naturally arises as to what difference there might be in current-carrying capacity between the solid and hollow anodes in a chromium plating bath. To answer that question the following experiment was conducted:

The two types of anodes were placed in the tank under identical conditions, so that at any given voltage, the total current through the system will indicate overall differences in current characteristics between the two anodes. Plating chromium on the cathode for a set length of time at a set current, the weight of chromium deposited, assuming 100 per cent efficiency, can be calculated. The weight increase of the cathode allows actual efficiency to be calculated. Then, by sectioning the cathode at intervals from the solution level down to the bottom, actual chromium deposited can be determined for each area and, based on actual and theoretical current efficiencies, the distribution of current on the anode can be approximated.

TEST CONDITIONS

	Round Anode	Flat Anode
Anodes	2 in. dia.	3 in. wide, ribbed
Anode length (effective)	19 in.	17 in.
Anode area	716.3 sq in.	767.3 sq. in.
Cathode	steel panel	steel panel
Cathode size	20⅜ by 10⅜ in.	20⅜ by 10⅜ in.
Cathode area		
—panel only	423 sq in.	423 sq in.
—with rack	543	543
Ratio anodes to cathodes	1.32:1	1.37:1
Ampere hours	675	675
Total tank current	450 amp	450 amp
Tank voltage (after stabilization)	5.25 v	5.55 v

Fig. 3.

Fig. 2. Homogeneous lead burned over copper hook. 2X

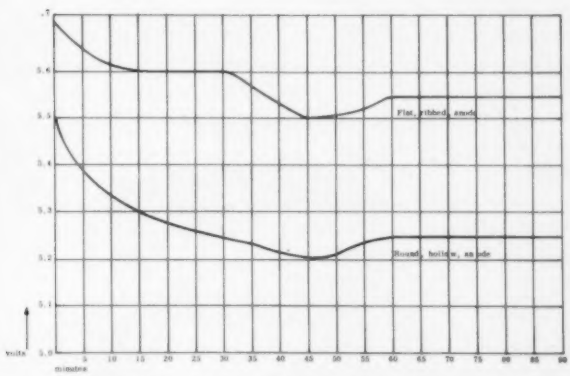
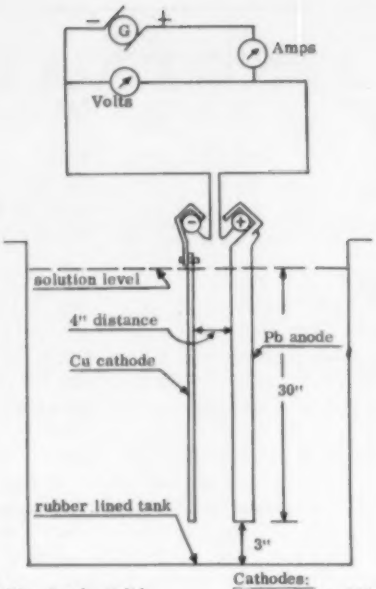


Fig. 4. Potential required to obtain equal current.



Anodes:
(a) 2" Dia. Lead - Solid
(b) 2" Dia. Lead - Hollow

Cathodes:
2" wide x .024" thick
Copper Strip - Nickel Plated

Plating Solution:
Chromic Acid Bath @120°F

Concentration:
45 ounces per gallon CrO_3

Plating Conditions:

(a) Volts: 5
Amps: 143
Time: 120 minutes
CD: 2.4 amp/in^2

(b) Volts: 5
Amps: 142
Time: 120 minutes
CD: 2.4 amp/in^2

Fig. 5. Tank Arrangement.

Fig. 5 shows the tank arrangement and plating conditions for the test. Fig. 6 is a graph of total weight of chromium deposited along the length of the cathodes. Fig. 7 plots the total weight of chromium deposited per square inch of cathode area along the cathode's centerline, disregarding the normal build-up along the edges. Fig. 8 shows the calculations used for the test.

It can be seen that, essentially, there is no difference between the hollow and the solid lead anodes under normal plating conditions.

Round anodes, solid or hollow, are also used extensively for

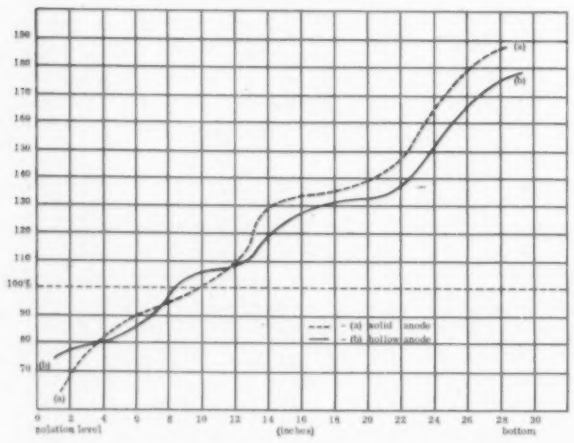


Fig. 6. Total weight of chromium deposited, including built-up edges. Theoretical weight of chromium deposited per square inch under test conditions = 100 per cent.

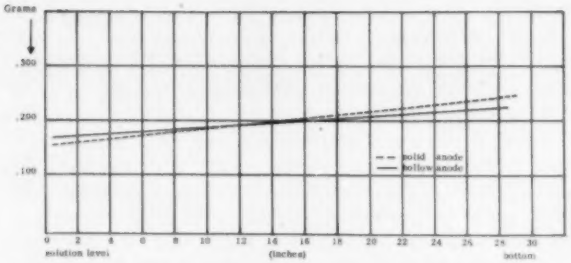


Fig. 7. Total weight of chromium deposited per square inch cathode area (Along centerline of cathode—disregarding edges.)

hard chromium plating and for applications where conforming anodes are needed, such as the inside of cylinders. Here, again,

CALCULATIONS

	Lead Anodes	
	Solid	**Hollow**
Tank voltage	5 v	5 v
Current	143 amp	142 amp
Time	2 hr	2 hr
Total ampere hours	286	284
Theoretical weight chromium (100% efficiency)	92.378 g	91.732 g
Actual weight chromium	13.11 g	13.60 g
Actual efficiency	14.2%	14.8%
Effective cathode area	56.62 sq in.	56.12 sq in.
Actual deposit per sq in.	0.231 g	0.243 g

Fig. 8.

uniform conductivity is of prime importance and a properly constructed anode will help greatly in producing a good plated product.

CONCLUSIONS

It has been demonstrated that the shape and the type of construction of a lead anode have an important bearing on the performance of the anode in the chromium plating bath. Good contact between the copper hook and the anode proper, by such means as homogeneous lead burning, and avoidance of dead spots or dead areas on the anode, are some of the factors which improve performance of the anode and thereby improve or produce a better plated part.

ACKNOWLEDGMENTS

The assistance of Republic Lead Equipment Company, Cleveland, Ohio, in furnishing lead anodes for some of the experimental work is gratefully acknowledged as well as their permission to publish some of the data included in this discussion.

Henry R Friedberg was born in Berlin, Germany, and received his high school and college education there. He is a member of the ASM, and Cleveland Branch, AES, in which he has held every office except Secretary, served on the Educational Committee for 1955 AES Convention, and is at present a Delegate. Mr. Friedberg is technical director of Crobaugh Laboratories.

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Report of 1958 Activities

COMMITTEE B-7

AMERICAN SOCIETY FOR TESTING MATERIALS

by R. F. HAFER
Reynolds Metals Company
AES Liaison with Committee B-7

Subcommittee I on Aluminum and Aluminum Alloy Ingots (D. L. LaVELLE, chairman) revised the Standard Specification for Aluminum for Use in Iron and Steel Manufacture (B37-57) to delete reference to specifying inspection at the point at which material is received: and revised the Standard Specification for Aluminum-Base Alloys in Ingot Form for Sand Castings, Die Castings, and Permanent Mold Castings (B179-58) to add 995A with conductivity requirements; to delete SC64A and SC64B, and add SC64D to replace them; and to delete reference to specifying inspection at the point at which material is received. The revisions in these specifications are in Appendix I of the report of Committee B-7 to ASTM.

Subcommittee II on Aluminum Alloy Castings (D. L. COLWELL, chairman) revised the Tentative Specification for Aluminum-Base Alloy Sand Castings (B26-58T) to add the additional tempers -F and -T71 for SG70A; to delete the higher temperature artificial aging treatment and add a melting range for ZC81A; and to delete reference to specifying inspection at the point at which material is received: and revised the Tentative Specification for Aluminum-Base Alloy Permanent Mold Castings (B108-58T) to add new alloys SC51B and SG70B (the high purity grades of SC51A and SG70A) in the -T61 temper, and the additional tempers -F and -T71 for SG70A; to add a melting range for ZC81B; and to delete reference to specifying inspection at the point at which material is received. The revisions in these specifications are in Appendix I of the report of Committee B-7 to ASTM.

The subcommittee cooperated in development of ISO Recommendation No. 258 on Definition and Classification of Composition of Aluminum Alloy Castings, which is now being balloted on by ISO/TC79.

Subcommittee III on Wrought Aluminum and Wrought Aluminum Alloys (H. D. MONSCH, chairman; R. A. HARRIS, secretary) prepared the new Tentative Specification for Aluminum-Alloy Pipe for Gas and Oil Transmission and Distribution Piping Systems and revised the following 15 tentative specifications.

Tentative Specifications for:

Aluminum-Alloy Sheet and Plate (B209-58T) to delete the beryllium limit and reduce the copper limit for GM51A (5456); to add the -0, -H32, and -H34 tempers for GM41A (5083) sheet; to correct the elongation and tensile strength for Clad CS41A-0 (Alclad 2014-0); to add minimum yield strength requirements for M1A-H16 (3003-H16), MG11A-H36 (3004-H36), G1A-H36 (5050-H36), and GR20A-H36 (5052-H36); to revise some thickness increments for tensile requirements; to exempt the manufacturer from conducting bend tests; and to delete reference to specifying inspection at the point at which material is received.

Aluminum-Alloy Drawn Seamless Tubes (B210-58T) to add the -H16 temper for M1A (3003), and the -H36 temper for MG11A (3004), G1A (5050), and GR20A (5052), all with minimum yield strength requirements; to add minimum wall thickness dimensions for tensile requirements for some alloys and tempers; and to delete reference to specifying inspection at the point at which material is received.

Aluminum-Alloy Bars, Rods, and Wire (B211-58T) to add M1A (3003) in the -0 and -H112 tempers, and GR40A (5154) in the -0, -H112, and -F tempers; and to delete reference to specifying inspection at the point at which material is received.

Aluminum-Alloy Extruded Bars, Rods, and Shapes (B221-58T), Aluminum-Alloy Extruded Tubes (B235-58T), and Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded (B308-58T), to delete the beryllium limit and reduce the copper limit for GM51A (5456); and to delete reference to specifying inspection at the point at which material is received.

Aluminum-Alloy Pipe (B241-58T) to delete the beryllium limit and reduce the copper limit for GM51A (5456); to revise the outside diameter and wall thickness tolerances for Schedules 5 and 10 pipe; and to delete reference to specifying inspection at the point at which material is received.

Aluminum-Alloy Drawn Seamless Tubes for Condensers and Heat Exchangers (B234-58T), Aluminum Bars for Electrical Purposes (B236-58T), Aluminum-Alloy Die Forgings (B247-58T), Aluminum-Alloy Drawn Seamless Coiled Tubes for Special Purpose Applications (B307-58T), Aluminum-Alloy Round Welded Tubes (B313-58T), Aluminum-Alloy Rivet and Cold Heading Wire and Rods (B316-58T), Extruded Aluminum-Alloy Bars, Rods, Pipe, and Structural Shapes for Electrical Purposes (B317-58T), and Type A and Type B Aluminum-Alloy Drawn Annealed Seamless Coiled Tubes (B318-58T) to delete reference to specifying inspection at the point at which material is received.

The subcommittee has a task group developing a Tentative Specification for Aluminum Foil for Capacitors, and a task group working on a major revision of the Tentative Specification for Extruded Aluminum-Alloy Bars, Rods, Pipe, and Structural Shapes for Electrical Purposes (B317).

The subcommittee assisted in the development of a new Tentative Specification for Aluminum-Alloy Welding Fittings as a participating member of a special coordinating committee comprising representatives of Committees B-2, B-5 and B-7.

Subcommittee IV on Magnesium and Magnesium Alloys, Cast and Wrought (A. A. MOORE, chairman; MRS. H. B. COMSTOCK, secretary) revised the following 7 standard specifications. Revision contained in Appendix of Committee B-7 report to ASTM.

Magnesium-Base Alloy Sand Castings (B80-58) to add new alloy K1A in the -F temper, and to delete reference to specifying inspection at the point at which material is received.

Magnesium-Base Alloy Sheet and Plate (B90-58) to add new alloys ZE10A in the -0 and -H24 tempers, and HM21A in the -T8 temper; to add limits for zinc, copper, and nickel for HK31A; to revise the tensile requirements for AZ31B and add tensile requirements for HK31A plate; and to delete reference to specifying inspection at the point at which material is received.

Magnesium-Base Alloy Forgings (B91-58), Magnesium-Base Alloys in Ingot Form for Sand Castings, Die Castings, and Permanent Mold Castings (B93-58), Magnesium-Base Alloy Bars, Rods, and Shapes (B107-58), Magnesium-Base Alloy Permanent Mold Castings (B199-58), and Magnesium-Base Alloy Extruded Tubes (B217-58) to delete reference to specifying inspection at the point at which material is received.

A task group is considering composition limits for high purity magnesium for nuclear applications.

(*Continued on page 849*)

ELECTROPLATING PROJECT WINS FOR YOUNG SCIENTIST

A 17-year-old New Jersey high school student, Lee Congdon, won first place in the chemistry division at the North Jersey Science-Mathematics Fair, an annual New Jersey institution sponsored by Fairleigh Dickinson University. Thirty-one high schools and 200 students participated in the science-mathematics fair held at Teaneck, N. J., the early part of April.

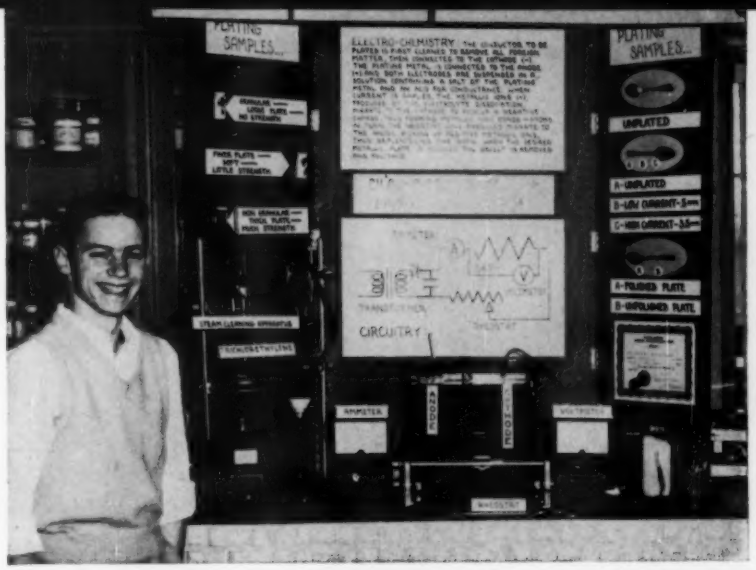
Young Congdon's accomplishment was brought to the attention of PLATING by Mrs. William O. (Ruebe Proctor) Preston, the daughter of Charles Henry Proctor, the founder of AES.

Lee Congdon attends Hanover Park High School, Hanover, N. J., where a course is offered in Research Science. As the name implies, it is a research course in which a student with the ability and interest may pursue a project of his choice. Recommendations of past science instructors are necessary for admission. Congdon is a member of this class of seven students. The consultant and advisor is Kendrick McCall, BA, MA, chairman of the Sciences.

"It was my task this past summer to choose a project," Lee Congdon told PLATING. "Since I have intense interest in physics and chemistry, and plan to make my vocation in either of these fields, I wanted my project to encompass both these sciences. After considerable search and elimination, electroplating was my choice.

"My first step was background reading in magazines, texts, papers etc. My lack of basic electrical theory, offered at the end of physics in the senior year, was one of my primary concerns. One might say I lacked the knowledge but possessed the drive. I started on my own, and eventually I was well enough versed in the basic theory to begin construction of the precleaning and plating units. Incidentally, most of my chemicals were ordered from a company through appropriations from the school."

Toward the end of October he began to accumulate the necessary equipment. The physics lab provided Heathkit multimeters, rheostat, transformer-rectifier and probes. The beakers, gas bottles, stands, funnel etc. were borrowed from the chemistry lab. He procured the tank, heater, cathodes and copper anodes, braces and other miscellaneous equipment.



Lee Congdon and the small-scale electroplating plant which won first place in its division at the North Jersey Science-Mathematics Fair.

The cleaning apparatus, utilizing trichorethylene is shown at the left in the above picture, and is of young Congdon's own design.

"The object to be cleaned," explained the youthful researcher, "is suspended from a rubber covered steel ring in the inverted gas bottle and subjected to a vapor bath of trichlorethylene. The emulsified impurities and condensed trichlorethylene are then dripped off into the filter paper and recovered in a container at the bottom. Naturally this operation is carried on under a vacuum hood because of the poisonous nature of the cleaner.

"My bath was an ordinary tropical fish tank; the sealer used was stable to my solutions. A regulated fish tank heater provided heat.

"For my anode material I chose copper as a representative metal, experimenting with variables such as temperature, current density, agitation, electrode area, and solution composition. Eventually I found that I could achieve a very rapid strong plate (250 mils in about 100 hours—0.5 amp at 1.1 volts) in a relatively short time. My bath consisted of 200 g of $CuSO_4$/liter, 28 g of H_2SO_4/liter, and distilled water. No additional agents were used.

"I did run into a deceiving metal after plating a number of forks and spoons. This metal was Cerbine, an alloy procured by one of my class members from his father at Bell Labs, Whippany. None of us knew what this alloy consisted of. My job was to plate this Cerbine in the form of a nozzle for this classmate's project on the Supersonic Wind Tunnel. The Cerbine, with a low melting point was to be melted out leaving the copper nozzle. Because of the placement of its constituents on the Electromotive Series, this alloy was quite inactive; the copper in the bath replaced one of the metals in the Cerbine. Because of this I could not get an adherent plate, only a black sludge. After a little experimenting, I found that alternate submersion of the alloy in the bath for about five-minute stretches and washing in water eventually built up a thin base coat without current. Later, the rest of the desired copper thickness was plated on in the normal manner and eventually the Cerbine melted out and the nozzle polished.

"At this point, toward the end of February, my plates were strong and very acceptable."

It was then that he began preparations for the North Jersey Science-Mathematics Fair. This occupied most of his time until April 3, 4 and 5, the fair dates. The project placed first in the chemistry division and he won a $20 self-contained bunsen burner, aside from a pin, certificate, and the recognition. In his division, there were about 30 other entries from the northern half of New Jersey. At the show, he actually plated a number of articles.

Since the fair, he has been studying the methods for making nonconductors conductive, and he is ready to begin plating in his small-scale tank.

Speaking of himself, he said, "I am a member of the National Honor Society. I belong to the yearbook art staff, and am art editor of the school newspaper, TRIAD. My hobbies involve work in the sciences, such as electroplating, art service of all types and roller skating. I am looking forward to the state competition in skating and hope this will eventually lead to national competition. My average of B+ for my high school career, representing five majors each year, has brought me acceptance to both the University of Rochester and Stevens Institute of Technology in Hoboken. I have chosen Stevens, and the science curriculum, and plan to enter this coming September."

It is a pleasure to send greetings to the members of American Electroplaters' Society assembled in their Golden Jubilee convention.

Your Society's contributions to science and technology are well known in our land and abroad. In celebrating its half-century of service to your industry, it is most fitting that you also include programs symbolizing constructive research and trade relations with those engaged in allied arts overseas.

I am delighted to add best wishes for a memorable convention.

DWIGHT D. EISENHOWER

Dr. W. Andrew Wesley
First Vice President

Ralph D. Wysong
President

Chester G. Borlet
Second Vice President

1959-1960
NATIONAL OFFICERS

Elected at the GOLDEN JUBILEE CONVENTION meeting of the Supreme Society, June 18, Ralph D. Wysong, Studebaker-Packard Corporation, South Bend, Indiana succeeded Herberth E. Head, Chrysler Corporation, as National President of the American Electroplaters' Society, Inc.

The Supreme Society also elected Dr. W. Andrew Wesley, International Nickel Co., First Vice President; Chester G. Borlet, Grand Rapids Brass Co., Second Vice President and Manuel Ben, Research Laboratories, General Motors Corporation, Third Vice President.

Mr. Head will serve on the Executive Board as immediate Past President and John P. Nichols continues as National Executive Secretary.

To these, PLATING extends its congratulations and its best wishes for effective and resultful tenure.

Manuel Ben
Third Vice President

Herberth E. Head
Past President

John P. Nichols
Executive Secretary

Arthur W. Logozzo

LOGOZZO, SWIFT ELEVATED TO AES HONORARY MEMBERSHIP

To the select circle of AES Honorary Members now reduced by death to a choice dozen, the Supreme Society, at its Annual Meeting held during the GOLDEN JUBILEE CONVENTION, elected two bright additions to that galaxy, namely Past President Arthur W. Logozzo of Hartford, Connecticut and Past President George P. Swift of Boston.

Championed for consideration by the AES's Hartford and Boston Branches and selected by the Society's Honorary Membership Awards Committee, Past Presidents Logozzo and Swift were ratified by the Executive Board. They were then nominated at the Supreme Society meeting and both were elected.

Each was supported in his nomination by a distinguished record of AES service. President of the Nutmeg Chrome Corporation, Mr. Logozzo was National President in 1949–1950. A Boston Consultant, Dr. Swift headed the Society in 1953–1954.

Dr. George P. Swift

A. KENNETH GRAHAM

A. KENNETH GRAHAM was born in Philadelphia, December 25, 1896. He attended the public schools. Upon graduating from the Central High School in 1915, he was awarded a City scholarship to the University of Pennsylvania. He graduated with a degree of BS in chemical engineering in June 1919, after having served ten months in 1918 with the U. S. Marines in World War I.

He then worked in the research department of the Scovill Mfg. Co., Waterbury, Conn. for two years. During this time he met and worked with George B. Hogaboom. This was the beginning of a life-long friendship. It was through this association that Dr. Graham became interested in electroplating and decided to specialize in this field.

Since there was no modern text on plating until Blum and Hogaboom published their book in 1923, Dr. Graham decided the best way to learn about plating was to work at it. This he did as a plater's helper from October 1920 until July 1921—first at the Hartford Sterling Co., Philadelphia, and then at the Welsbach Co., Gloucester, N. J.

The summer of 1921 Dr. Graham studied metallography at Columbia University. This was followed by five years in the graduate school of the University of Pennsylvania, during which time he served as Instructor in Chemistry and completed work leading to a technical degree of ChE and graduate degrees of MS and PhD.

After a six-month bout with an ulcer, Dr. Graham delivered his first paper before the AES at the convention in Newark in June 1926, for which he later received a medal award.

He then joined the Hanson-Van Winkle Company of Newark, N. J. and became associated with George Hogaboom for the second time. He installed a laboratory at Newark and later at Matawan, N. J., when the Hanson company joined with Munning. During this period the simplified methods of analysis for plating baths were developed, the course for platers was first offered, the standard solutions for analyses were made available for platers, and the zinc-aluminum anode, which later became patented, was developed.

Starting in the fall of 1928, Dr. Graham has held the following positions.

University of Pennsylvania, Philadelphia, Pa., Instructor and Assistant Professor in Chemical Engineering, September 1928 to February 1937.

A. Kenneth Graham & Associates, Jenkintown, Pa., Consulting Engineer, July 1936 to June 1942.

War Production Board, Washington, D. C., Plating Consultant and Deputy Chief, Products Branch, Conservation Division, June 1942 to June 1943.

Houdaille-Hershey Corp., Decatur, Ill., Director of Research and Development, Garfield Division, June 1943 to August 1944. Graham, Crowley & Associates, Inc., (later becoming Graham, Savage & Associates, Inc.), Jenkintown, Pa., President, September 1944 to date.

Dr. Graham joined the Newark Branch of the AES in 1926. In 1928, he transferred to the Philadelphia Branch. He organized and taught the first chemistry class for the Philadelphia Branch of the AES. He has won three gold medal awards for papers from the AES. He served as Executive Secretary of the Society from 1945 to 1951, during which time the monthly publication was changed from the small size MONTHLY REVIEW to the present format of PLATING. He was elected an Honorary Member of the Philadelphia Branch in 1957.

He is also a member of the Institute of Metal Finishing, ASTM, ACS, AIChE, Association of Consulting Chemists and Chemical Engineers, Inc., and The Electrochemical Society. He has been active on committees of most of these societies and served as manager and vice president of The Electrochemical Society for eleven years.

He has published over forty technical papers, obtained several patents, contributed chapters to Modern Electroplating by Gray, the ACS Monograph on Copper by Butts, and the Electroplating Engineering Handbook, for which he also served as Editor-in-Chief.

AES NEWS

DR. A. KENNETH GRAHAM AWARDED AES's HIGHEST SCIENTIFIC HONOR

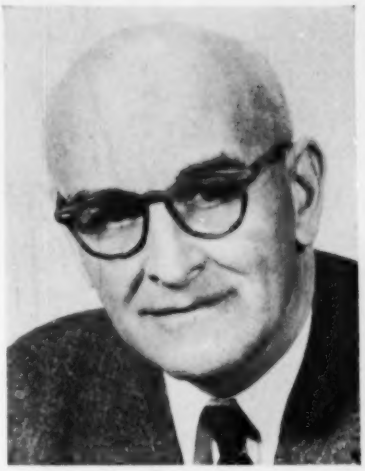
American Electroplaters' Society, Inc. (AES) climaxing its FIFTIETH ANNIVERSARY observance with a massive five-day GOLDEN JUBILEE Convention and Industrial Finishing Exposition, including the Fifth International Conference on Electrodeposition and Metal Finishing, held in Detroit, Michigan, June 15–19, 1959, also named the second winner of its AES Scientific Achievement Award, the Society's highest scientific honor. It selected for that coveted award, the distinguished scientist, Dr. A. Kenneth Graham of Jenkintown, Pennsylvania, president of Graham, Savage & Associates of that city.

The selection of Dr. Graham as the second winner of that honor was announced to the vast audience attending the Grand Opening Session of the GOLDEN JUBILEE CONVENTION held in the Grand Ballroom of Detroit's Statler-Hilton Hotel, Monday morning, June 15. The report was made by Dr. Abner Brenner of the National Bureau of Standards, chairman of the Selection Committee, itself composed of well-known scientists, namely Myron B. Diggin, Dr. Russel E. Harr, Dr. Edward A. Parker, Dr. Louis Weisberg and Dr. Samuel Heiman.

Among those present at that meeting was Dr. William Blum, who as the first winner of the same Award, delivered the first "William Blum Lecture" before an overflow audience at the Opening Session of the Fifth International Conference on Electrodeposition and Metal Finishing in the Statler-Hilton Ballroom that very same afternoon.

Dr. Graham, like Dr. Blum, earned selection by his "decade-plus" accomplishments in advancing the theory and practice of electroplating, metal finishing and allied arts; in raising the quality of its processes and products, and in enhancing the dignity and status of the profession. He was nominated for the Award by the Philadelphia Branch, AES's second oldest chartered Branch that in 1960 will be celebrating its own Golden Anniversary.

Dr. Graham will deliver the second "William Blum Lecture" at the AES's Annual Convention to be held in Los Angeles in 1960. He will receive a scroll, a $500 honorarium and other attendant honors.



Dr. A. Kenneth Graham
Second Winner
AES Scientific Achievement Award

Dr. William Blum

BLUM FEATURED SPEAKER OF INTERNATIONAL CONFERENCE

Dr. William Blum, first AES Scientific Achievement Award winner, delivered the first "William Blum Lecture," a feature of the GOLDEN JUBILEE CONVENTION, launching the AES's International Conference on Electrodeposition and Metal Finishing in the Grand Ballroom, Statler-Hilton Hotel, Detroit, Monday, June 15, 1959. He was honored immediately after the lecture by the awarding to him of a handsome Scroll plus a $500 honorarium by National President Herberth E. Head in behalf of a grateful and admiring AES.

Dr. D. G. Foulke

Dr. Walter R. Meyer

John J. Dale

THREE AES MEMBERS RECEIVE AWARDS OF MERIT

Awarded by the Executive Board for meritorious service to the American Electroplaters' Society, the Board voted its Award of Merit during the GOLDEN JUBILEE to three AES valiants, namely John Dale of Australia, Dr. Walter R. Meyer and Dr. D. Gardner Foulke. The presentation was made by National President Herberth E. Head at the Second Business Session of the Supreme Society held at the GOLDEN JUBILEE CONVENTION, Thursday, June 18, 1959.

HAPPENINGS AT THE GOLDEN JUBILEE CONVENTION

Detroit, Michigan, Sunday and Monday, June 14-15

(1 & 2) First registrants pour in on Sunday. (3) Early arrivals chatting in the ballroom foyer. (4) The Credentials Committee meets with the Executive Board on Sunday. Left to right, Dr. W. Andrew Wesley, 2nd vice president; Francis T. Eddy, past president; John P.Nichols, national executive secretary; Herberth E. Head, president; Cleveland F. Nixon and Dr. George P. Swift of Credentials Committee; Ralph D. Wysong, 1st vice president; Chester G. Borlet, third vice president. (5) Meeting of the Honorary Membership Committee, l. to r., Leslie L. Diveley, Louis W. Gagnon, Charles C. Conley and Kenneth M. Huston. (6) The Golden Jubilee Get-To-Gether Party. (7) Huge audience at the Grand opening of the Golden Jubilee Convention. (8) President Head; Keynote Speaker Irving A. Duffy, vice president, Ford Motor Co.; and Joseph Gurski, Ford Motor. (9) Dr. T. P. Hoar, president, Institute of Metal Finishing, London; John P. Nichols; Herberth E. Head; Michigan Lieutenant Governor John B. Swainson; Convention General Chairman Wright W. Wilson. (10) Winners of the Paper Awards, l. to r., Dr. Edward B. Saubestre, Enthone, Inc., recipient of two awards; Dr. Abraham M. Max, Radio Corp. of America; Donald R. Millage and Wilbur E. Hague, Udylite Research Corp. (11) The Lieutenant Governor greets the conventioneers. (12) International audience standing for the National Anthems. (13) Branch Secretaries luncheon. (14) Editorial Board in session. (15) President Head conducting first business session on Monday morning. (16) Audience at the first Educational Session. (17) Dr. William Blum, seated; Dr. T. P. Hoar, at microphone; and Walter L. Pinner, at the opening of the Fifth International Conference. (18) Dr. William Blum first winner of the Scientific Achievement Award, delivering the first William Blum Lecture. (19 & 20) Scenes at the AES Golden Jubilee Open House, sponsored by the MFSA. (21) Order of Past Presidents business meeting. (22) Past Presidents dinner. (23) PLATING readies its exhibit at the Golden Jubilee Lounge at the Artillery Armory. (24) Another view of the Monday Business meeting of the Supreme Society. (25, 26 & 27) Shots of the AES Golden Jubilee Lounge prior to the official opening of the Exposition.

George J. Hetz

Tony Stabile

Earl W. Arnold

LOS ANGELES CONVENTION TARGETED TO DRAW LARGE AES AUDIENCE TO WEST COAST

Three decades ago, growing AES pushed beyond the Rockies and penetrated the Pacific Coast with a Branch chartered in Los Angeles, California, then a municipality of slightly over a million population. In midsummer 1960, AES will return to that bustling community and, with its livewire Los Angeles Branch as Host, will conduct its 47th Annual Convention at the Statler Hotel of that city, first AES Convention ever held on our nation's Far Western frontier.

Los Angeles is a metropolis of many traits, attributes, facilities and attractions qualifying it as an outstanding site for a large Society Convention. Distance and travel expense, however, are drawbacks.

So as to justify the long cross-country migration of the AES family, the Los Angeles Branch is preparing the type of Convention that will attract large audience regardless of distance.

With dates set for July 24–28 so as to enable families to travel during vacation time, the main appeal of the Convention is being beamed to the mission of the AES, namely educational enrichment. Educational Sessions are being planned of such quality and appeal as to warrant distant travel. Sightseeing, plant tours, entertainment, fellowship events are being targeted to round out an attractive Convention package—a worthy follower in '60 of AES's GOLDEN JUBILEE CONVENTION of '59.

General Convention Chairman is Tony J. Stabile with Branch President George J. Hetz as Co-Chairman. Earl W. Arnold is Host Branch Educational Chairman.

STRONG REPLACEMENTS NAMED TO AES's BUSY COMMITTEES

To man AES standing Boards and Committees for three-year terms effective with the First Business Session of the Supreme Society held during the recent GOLDEN JUBILEE CONVENTION, the Executive Board appointed these AES stalwarts:

EDITORIAL BOARD:
Dr. Henry L. Kellner, Dr. Joseph V. Petrocelli, Dr. Edward B. Saubestre and Earl W. Arnold (1 year)

EDUCATIONAL COMMITTEE:
(To be appointed)

HONORARY MEMBERSHIP AWARD COMMITTEE:
Anthony P. Julius, Dr. Samuel Heiman

MEMBERSHIP COMMITTEE:
Myron Browning, John J. Bunsic, George W. Taylor

PUBLICATIONS COMMITTEE:
Francis T. Eddy, W. Wallace Sellers, Paul A. Waalkes

PUBLIC RELATIONS COMMITTEE:
Robert M. Norton, Kenneth C. Riefsteck, Eugene Roth

RESEARCH COMMITTEE:
Richard A. Fellows, Edward J. Kubis, Dr. Harold J. Wiesner

SCIENTIFIC ACHIEVEMENT AWARD COMMITTEE:
Dr. Henry B. Linford, Dr. Harold J. Wiesner

To each, AES extends congratulations and the hearty wish that his tenure will be bright. PLATING MAGAZINE joins in these good wishes.

Photograph courtesy of Plating Management

SAL NOVELLI NAMED PLATING MAN OF THE YEAR

Silvestro Novelli, popular Service Plating Company executive, was named 1958-1959's "PLATING MAN OF THE YEAR" by the Masters' Electro-Plating Association Inc. (MEPA) and received that MEPA highest honor midst thundering applause at the Association's outstanding 41st Annual Banquet, a sumptuous event held May 16 in the Grand Ballroom of the Plaza Hotel, New York. Some 300 MEPA members and their guests were present. Above, MEPA's Executive Secretary Alfred T. Marinaro presenting the handsome scroll to Sal Novelli. At extreme left, Mariano Ranno and Frank Kaiser at the extreme right.

A direc'or of MEPA, Sal is also an officer and director of the National Association of Metal Finishers. Other MEPA officers include Mariano Ranno, chairman, Leonard Kornblum, vice chairman, and Frank Kaiser, treasurer. One of the social highlights of the season, the Banquet, jointly headed by Messrs. Kaiser and Novelli, featured decor, menu, service and star-studded entertainment, including well-known Al Bernie, Cardini himself and Tina Robin.

Donald R. Millage

Dr. A. M. Max

Dr. E. B. Saubestre

Dr. Ernst Raub

Wilbur E. Hague

EXTRACTS FROM THE PAPER AWARD COMMITTEE'S REPORT

"The Paper Awards Committee has reviewed the papers appearing in PLATING MAGAZINE (March 1958 through February 1959) and in the 1958 Edition of "Technical Proceedings." We operated under the Constitution and Bylaws of the Society under Appendix, page 10, of the April 1, 1958 issue. The Committee was unanimous in its decisions. . .

"Since there were less than three papers in the categories covered by the Precious Metals Award and the John J. Hanney Award, no selections were made for these Awards. This minimum is set down in Section 3, General Considerations for Awards.

"The Committee also ruled that there were no papers of sufficient merit on the subject of mechanical finishing to warrant an award in that category."

AES PAPER AWARD COMMITTEE
O. B. Kirchoff
R. Scott Modjeska
F. O. Beuckman, Chairman

TO ALL BRANCH SECRETARIES

A complete list of all of your Branch Members in good standing as at June 30, 1959 is due in the hands of the National Executive Secretary by not later than July 15, 1959 as per Part II, Article V, Section 4 of the AES Bylaws. Your Branch will be billed for Per Capita Taxes for the fiscal year commencing July 1, 1959 and ending June 30, 1960 shortly thereafter based upon your filed list.

The tenure of your accredited Delegates/Alternates expires at the first Branch meeting following the June 18, 1959 Annual Meeting of the Supreme Society (or until their successors are duly elected and qualify). A list of your elected 1959-1960 Delegates/Alternates is due in the hands of the National Executive Secretary by not later than November 2, 1959 as per Part II, Article VII, Section 1 of the AES Bylaws.

FIVE AES AUTHORS HONORED AT GOLDEN JUBILEE CONVENTION

The American Electroplaters' Society bestows eight awards for original technical and scientific contributions that have appeared in PLATING MAGAZINE and "Technical Proceedings" during the fiscal year just ended. The Paper Awards Committee appointed by the Society's National President, selects these papers on the basis not only of their immediate value to the plating and metal finishing industries but also of the technical and scientific value and originality of their subject matter and the clarity of their presentation.

The GOLDEN JUBILEE YEAR (1958–1959) winners follow.

THE CARL E. HEUSSNER AWARD (AES GOLD MEDAL)

For the best paper printed in Society publications during the fiscal year. Consists of Gold Medal, Award certificate and $250. Co-sponsored by AES and the United Platers' Foundation, Glenn H. Friedt, Trustee.

Awarded to "The Chemistry of Watts Nickel Plating Solutions" by Dr. Edward B. Saubestre, Enthone, Inc. (September 1958 issue PLATING MAGAZINE, Page 927).

THE AES SILVER MEDAL

For the second best PLATING or Convention paper during the fiscal year. Consists of Silver Medal and $150 cash award. Sponsored by AES.

Awarded to "Factors which Influence the Structure of Electrodeposits" by Dr. Abraham M. Max, Radio Corporation of America ("Technical Proceedings," 1958 Edition, Page 73).

THE AES BRONZE MEDAL

For the third best PLATING or Convention paper during the fiscal year. Consists of Bronze Medal and $50 cash award. Sponsored by AES.

Awarded to "Research on Microthrowing Power and Leveling of Plating Baths" by Dr. Ernst Raub, Research Institute for Noble Metals, Schwaebisch Gmuend, Germany (May 1958 issue PLATING MAGAZINE, Page 486).

THE GEORGE B. HOGABOOM AWARD

For the best paper on nickel plating printed in Society publications during the fiscal year. Consists of $75 cash award and an Award Certificate. Co-sponsored by AES and its Hartford Branch.

Awarded "The Chemistry of Watts Nickel Plating Solutions" by Dr. Edward B. Saubestre, Enthone, Inc. (September 1958 issue PLATING MAGAZINE, Page 927).

THE CHROMIUM PLATING AWARD

For the best paper on the subject of chromium plating appearing in Society publications during the year. Consists of cash award of $50 and an Award Certificate. Co-sponsored by AES and the Nutmeg Chrome Corporation.

Awarded to "Pitting in Thick Chromium Deposits" by Donald R. Millage and Wilbur E. Hague, The Udylite Corporation ("Technical Proceedings," 1958 Edition, Page 118).

For the reasons specified in the adjoining report by the Paper Awards Committee, the Robert S. Leather Mechanical Finishing Award; the Precious Metal Plating Award and the John J. Hanney Memorial Award were not this year awarded.

NEW DENVER BRANCH GRANTED TEMPORARY CHARTER

On the heels of temporarily chartering AES's new Phoenix (Arizona) Branch, the Executive Board has now awarded a temporary charter to the new Denver Branch effective May 7, 1959.

With a nucleus of thirty-one members, Denver Branch qualified for temporary charter as provided by the AES Constitution. By successfully operating a minimum of three months under temporary charter, the Denver Branch, like the Phoenix Branch, will be eligible then to apply for permanent charter and thereby for an equal place within the circle of the Society's chartered Branches in the United States, Canada and Australia.

At such a time, both Branches will be installed at installation ceremonies in their communities of record by AES installation teams composed of the Society's National Officers.

INTERSOCIETY NEWS

CHAIRMEN NAMED FOR NORTHEAST NACE CONFERENCE

Symposia chairmen have been selected for the October 5–8 Northeast Region Conference of the National Association of Corrosion Engineers to be held at the Lord Baltimore Hotel in Baltimore, Maryland.

Seven symposia in the technical program and their chairmen are:

Theories and Principles Symposium: Fred M. Reinhart, supervisory materials research engineer in the corrosion section, Division of Metallurgy, National Bureau of Standards, Washington, D. C.

High Temperature Corrosion Symposium: Hugh L. Logan of the National Bureau of Standards, Washington, D. C.

Corrosion in Handling Water Symposium: Sheppard T. Powell, Sheppard T. Powell and Associates, Baltimore, Maryland.

Cathodic Protection Symposium: Sidney Tudor, supervisory chemist in charge of electrochemistry unit at the Material Laboratory, New York Naval Shipyard, Brooklyn, New York.

Protective Coatings Symposium: Leon Birnbaum, head of the Preservation, Decking and Insulation Section of the Navy Department's Bureau of Ships, Washington, D. C.

Corrosion Inhibitors Symposium: Alfred Douty, technical director, Amchem Products, Incorporated, Ambler, Pennsylvania.

Special Corrosion Topics Symposium: Carl J. Wessel, director of Prevention of Deterioration Center, National Academy of Sciences, National Research Council, Washington, D. C.

ASME CONFERENCE HELD

A five-day national conference on men, machines and industry was held in St. Louis, Missouri, last month.

The semi-annual meeting of The American Society of Mechanical Engineers, from June 14–18 at the Chase-Park Plaza Hotels, included such topics as engineers and management, cost reduction, power reactor fuels, direct conversion of heat into electrical energy, automobile tires and engines and air pollution.

Aviation sessions were a featured part of the program.

Over one thousand engineers and businessmen attended the ASME convention.

More than thirty technical sessions were scheduled and several speakers addressed the meeting at luncheons and other special events. The speakers include Glenn B. Warren, president of ASME and vice president of the General Electric Co.; Raymond B. Tucker, Mayor of St. Louis, Howard K. Nason, vice president of the Monsanto Chemical Co., St. Louis; and other prominent men.

ISA SYMPOSIUM TO BE FEATURE AT PHILADELPHIA

A symposium, sponsored by the Philadelphia Section of the Instrument Society of America, will be presented November 23–24, 1959 at the Ben Franklin Hotel, Philadelphia.

The theme of this symposium will be "Solid Facts about Solid State"—examining the theory and application of solid state techniques in modern instrumentation. Technical papers by leading authorities in the field will be presented and a display of solid state devices will be featured.

On the evening of Nov. 23, a cocktail party and banquet, with a well-known guest speaker, will be held in the main ballroom of the hotel.

FIVE SYMPOSIA FOR NACE REGION CONFERENCE IN CLEVELAND

Five symposia are complete in the technical program for the 1959 North Central Region Conference of the National Association of Corrosion Engineers to be held October 20–22 in Cleveland, Ohio. Topics and speakers are:

Protective Linings and Coatings: Spray Metal as a Base for Coating by E. C. Warner, Akron Sandblast Company; Vinyl Coatings by C. Munger, Amercoat Corporation; Epoxy Coatings by N. A. Mason, Pittsburgh Plate Glass; and New Developments in Protective Linings by Wallace Cathcart, Tank Lining Corporation.

Cathodic Protection Symposium: John Rohwedder, Corps of Engineers, Rock Island, Illinois and Art Ericson, Peoples Natural Gas Co., Pittsburgh.

Chemical Treatment Symposium: W. A. Hess, Standard Oil Company.

Materials of Construction—Metals Symposium: E. D. Verink Jr., Aluminum Company of America; F. L. Whitney Jr., Monsanto Chemical Company and T. P. May, International Nickel Company.

Plastics Symposium: Otto Fenner, Monsanto Chemical Company; F. W. Arndt, Heil Process Equipment Corporation and G. C. Anderson, National Tube Company.

General Chairman of the conference is Lester D. Mills Jr., of Standard Oil Company of Ohio. E. W. Vereeke, Heil Process Equipment Corporation is chairman of the technical program.

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ASTM COMMITTEE B-7 REPORT

(*Continued from page 838*)

Subcommittee V on Testing Light Metals (J. C. MILLSON, chairman), through having representatives on the Test Methods Panel of the Joint ASTM-ASME Committee on the Effect of Temperature on the Properties of Metals, has been instrumental in having the Tentative Recommended Practice for Short-Time Elevated-Temperature Tension Tests of Materials (E21) revised to add strain rates.

The subcommittee has been unable to obtain agreement on expressing stress values in terms of *thousands of pounds per square inch* in B-7 specifications, and no progress has been made in developing sampling requirements based on statistical methods because Committee E-11 on Quality Control of Materials has been unable to formulate recommendations.

A task group has recommended the following minimum dimensions for round and flat sub-size tensile test specimens for cast and wrought light metals and alloys: Round specimens: — reduced section, ¼ in. dia. x 1 in. gage length; grip ends, ⅜ in. dia.; total length 3 in. if tested with threaded or shouldered ends, or 4 in., if tested with wedge grips. Flat specimens: — reduced section, ¼ in. wide x 1 in. gage length; grip ends, ⅜ in. wide; total length, 4 in.

Subcommittee VI on Anodic Oxidation of Aluminum and Magnesium Alloys (R. F. HAFER, chairman; L. H. ADAM, secretary) is revising Standard Methods of Measuring Thickness of Anodic Coatings on Aluminum by Means of the Filmeter (B244-56) to include other film measuring instruments, and has completed a proposed Tentative Specification for Anodic Coatings on Aluminum and Aluminum Alloys with the exception of an appendix.

Subcommittee VII on Codification of Light Metals and Alloys, Cast and Wrought (C. B. GLEASON, chairman; W. G. SNYDER, secretary) revised the Standard Recommended Practice for Codification of Light Metals and Alloys, Cast and Wrought (B275-58) to delete reference to Tentative Recommended Practice for Designating Significant Places in Specified Limiting Values (E29) because the 1958 revision no longer contains the rounding-off method used in establishing ASTM designations for light metals and alloys in accordance with B275. The revision of B275 adds the rounding-off method formerly in E29.

Subcommittee VIII on Atmospheric Exposure Tests (L. H. ADAM, chairman; D. L. COLWELL, secretary) has test specimens of aluminum and magnesium alloys, cast and wrought, at five ASTM atmospheric exposure test sites: on top of the Port of Authority Building, New York City, for industrial atmospheric conditions; at State College, Pennsylvania, for rural; at Kure Beach, N. C., for Atlantic Coast marine; at Point Reyes, California, for Pacific Coast marine; and at Freeport, Texas for Gulf Coast marine atmospheric conditions. The data on exposure for six months, one year, and three years are complete. The specimens exposed for five years at New York City, State College, and Kure Beach are being tested, and at Point Reyes and Freeport are being removed for testing. Data obtained from wrought aluminum and magnesium alloys exposed for three years are contained in the appendix to Committee B-7 a report to ASTM.

Subcommittee IX on Editorial (R. A. HARRIS, chairman) is preparing Recommendations on Form of ASTM Committee B-7 Specifications to supplement Proposed Recommendations on Form of ASTM Specifications, April 1957, which have been approved as a guide, insofar as practical, for writing and revising B-7 specifications. Standardization of section titles, sequence, and wording, and form, titles, and headings of tables is being attempted.

Special Subcommittee on Light Metals for Nuclear Applications (W. G. GROTH, chairman; H. G. WARRINGTON, secretary) is cooperating with Subcommittee IV in developing requirements for high purity magnesium in ingot form of a quality suitable for use as a reducing agent in the production of nuclear grade metals.

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New Construction for longer Service . . .

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Heavy gauge steel with wire woven through steel angle firmly attached to main stem. Cannot come apart or loosen. Side clip is for STUTZ BARREL PLATING TANKS having submerged rectangular anode bars. Side clip not furnished for racked plating tanks. Standard hook 6 inches. Other hook lengths furnished in quantity of 100 or more.

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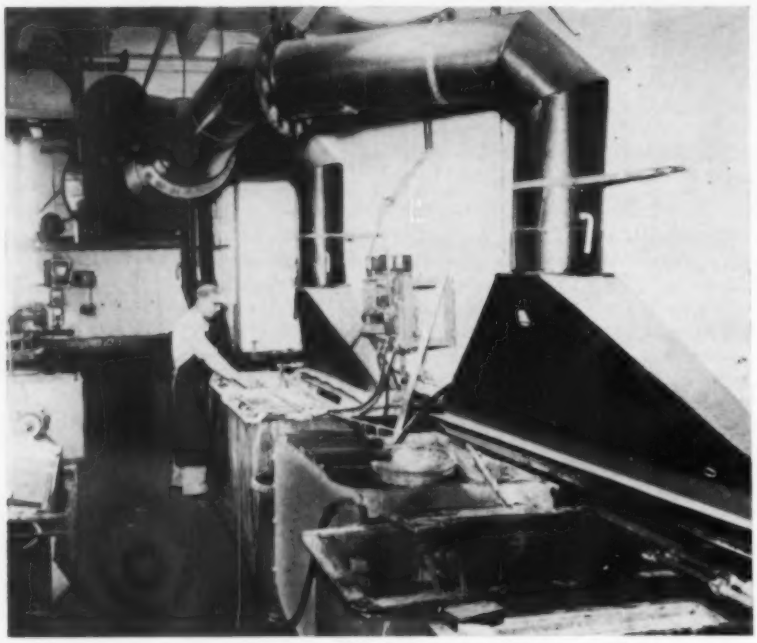
INDUSTRY NEWS



Exhaust system at the Hickock Instrument plant in Cleveland, Ohio

HICKOCK CUTS EXHAUST SYSTEM MAINTENANCE WITH POLYETHYLENE

A costly operating problem of the Hickok Electric Instrument Co., was the continuing failure of its exhaust system due to corrosive liquids and fumes.

This Cleveland manufacturer of radio and television test equipment uses many caustic chemical solutions in its plating department and an effective exhaust system is vital to the health of its employes.

All three fume hoods are connected to the central exhaust system for removal of the toxic fumes.

The initial system consisting of a fume hood over each of three tanks was constructed of 14-gauge steel which only operated satisfactorily for less than a year before it was rendered useless by the corrosive fumes and liquids.

A second system was constructed of 18-8 stainless steel. This system operated for five years but required constant maintenance and proved extremely costly.

For this reason, when the stainless steel system could no longer be repaired, Hickok sought another solution to its exhaust system corrosion problem and called on American Agile Corp. engineers to design a polyethylene system.

On the basis of Agile's report, Hickok approved the polyethylene system. The installation called for three rear tapered fume hoods, 6 ft lay fitted with 8–12–18 and 22 in. diameter exhaust ducting fitted with damper for flow control. Also breeching 24 by 30 in. to connect fan to brick exhaust stack.

The system has been in operation for seven years and is still considered "almost as good as new." The only maintenance required is an annual flushing with hot water.

Hickok is presently building a new plating department and will transfer the complete exhaust system, with only slight modifications, to the new location.

FULLER-REYNOLDS TO HANDLE INDUSTRIAL CHEMICALS

A new company, Fuller-Reynolds Chemicals, Inc., has been formed to warehouse and sell industrial chemicals in central Indiana. Facilities have been established in Tipton, Indiana. Officers of the corporation are Ira K. Fuller, president, M. Les Reynolds, formerly with Wm. Lynn Chemical Co. Inc., vice president and treasurer, Robert A. Stewart, secretary. Mr. Reynolds will also serve as director of sales.

KOCOUR THICKNESS TESTER SERVICED IN CANADA

Kocour Company of Chicago, Illinois has appointed the Canadian Research Institute, 46 St. George St., Toronto, Canada as an authorized service agency for its electronic thickness tester.

This move makes available a convenient source of repair to Canadian customers direct or through Canadian distributors.

DRESSER ELECTRIC MOVES TO NEW PLANT

Dresser Electric Co. has moved to a new and larger plant at 2705 Wight Street, Detroit. This expansion of facilities enables Dresser to increase their services.

CHEMICAL INDUSTRIES 27TH BIENNIAL EXPOSITION

More than 450 manufacturers have already engaged space for displays at the 27th Exposition of Chemical Industries, representing a large proportion of the entire area available on the four floors of the New York Coliseum, where the Exposition will be held Nov. 30 to Dec. 4.

Displays include chemical processing equipment, chemical materials, and the metals, plastics and other substances employed in mechanical construction of every kind, as well as functional units and component parts.

One section of the exhibition will be devoted to chemicals, including ingredients of extremely high purity, new derivatives offered for the improvement of existing products; and samples of end products manufactured with the aid of new formulations.

Another section will be devoted to laboratory equipment and supplies. The array of new instruments will incorporate many examples of advanced design.

The display of processing equipment will run through the alphabet from agitators and ammoniators, blenders and blowers, classifiers and concentrators to dissolvers, evaporators, filters, heat exchangers, homogenators, impregnators and so on.

Visitors register from the entire United States and from many points north and south of the border, as well as from overseas—from some 40 foreign countries according to the latest analysis. Registered admissions, exclusive of exposition personnel, totaled upwards of 40,000 at the last exposition, two years ago.

Admission is by invitation and registration only. The general public will not be admitted.

COMMERCIAL FILTERS APPOINTS MICHIGAN REPRESENTATIVE

The Jesse W. Eakins Corp., Detroit, Michigan, has been appointed to represent Commercial Filters Corp. in Michigan. Products include the complete line of filters for micro-filtration of industrial fluids, filters for coolants, cutting oils, quenching oils, rolling oils, lubricants, and paint spray booth water. The Eakins address is, 15785 James Couzens Highway, Detroit 38.

UDYLITE VISITED BY STUDY TEAM FROM JAPAN

The Japanese electroplating study team under the auspices of the International Cooperation Administration of Washington visited the plants of The Udylite Corporation on May 11. This team consisted of twelve Japanese heads of electroplating shops or manufacturing firms doing electroplating in Japan. As these team members did not speak or understand english they were accompanied by two interpreters and the program planner Bill J. Zouras of John A. Patton Management Engineers, Inc., of Chicago.

These Japanese visitors were greeted in front of the Udylite administrative offices on East Grand Boulevard by Leon K. Lindahl, chairman of the board of directors; L. V. Nagle, executive vice president; Gust Kentta, head of process engineering; Sam Chmielewski, personnel director; and R. C. Trees, director of public relations, together with his assistant, Arthur Sieloff.

Japanese electroplating study team at The Udylite Corporation administrative offices in Detroit, Michigan.

The group was then addressed by Mr. Kentta on the subject of electroplating processes and the proper cycles involved in American practices of electroplating. Following that discussion, the group was addressed by Chet Clark, head of Udylite's engineering, who showed the Japanese visitors the procedures involved in planning and engineering equipment for electroplating.

The group was then taken on a Belle Isle tour and to a luncheon at the Detroit Yacht Club.

After lunch the Japanese team was taken to the Udylite manufacturing plant on Hoover Road to see all the operations involved in manufacturing Udylite electroplating processes and equipment. They then toured the building of the Udylite Research Corp. and wound up with an address by Dr. Henry Brown, director of Udylite research, on the subject of various types of decorative plates and their corrosion resistance.

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NEW CHROMIUM SYSTEM ANNOUNCED BY M&T

A new chrome plating process was announced at a press meeting in Detroit on May 26.

"Duplex Chromium," based on processes developed by Metal & Thermit Corp., is claimed to apply a thicker layer of chromium than ever before possible and increases corrosion and rust resistance up to 500 per cent.

"Accelerated laboratory tests demonstrate this new process can add years to the life of chrome plated trim on automobiles, even in areas where the atmosphere is regarded as highly corrosive," according to H. D. McLeese, Metal & Thermit vice president.

"Several automobile manufacturers have started using this new method to chrome plate bumpers, grille-work and other exterior trim, and others are planning to use it," Mr. McLeese added.

The increasing use of salt and other chemicals for winter snow removal, together with the presence of industrial fumes in many metropolitan areas, are factors responsible for early pitting and corrosion of chromium plated automotive trim. This problem has been recognized throughout the automotive industry and various attempts have been made to solve the problem, including thicker undercoats of copper and nickel and protective coatings of wax or lacquer.

Speakers at the Metal & Thermit press conference. (Left to right) Dr. Edgar J. Seyb, research supervisor, M & T's Electrochemical Research Laboratories; H. D. McLeese, vice president; and Henry Mahlstedt, product manager, plating, explaining corrosion on a production part.

"The new Duplex Chromium process consists of the successive application of two different types of bright chrome plate. The first provides especially good covering and throwing power to plate more uniformly even in hard-to-reach recesses; the second builds up the total thickness of

(*Continued on page 868*)

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INDUSTRY NEWS BRIEFS

BOOKLET GIVES CORROSION TEST RESULTS

Results of a corrosion test evaluation program for metallized coatings have been made available by the American Welding Society after an exposure period of three years. The findings are on the corrosion resistance of metallized coating and reveal the resistance to many corrosive environments.

Over 4300 specimens were exposed at eight test sites. The major objectives are to determine the life of the coating in each environment, to determine the effect of various methods of preparation of the steel, and to determine the increase in life of the zinc and aluminum coatings with seal coatings added.

The AWS Committee on Metallizing selected locations where panels could be exposed to rural, industrial, salt-air and salt-spray environments. Panels were to be examined at 3, 6, 9 and 12 year intervals.

An illustrated reprint of the complete report giving test sites, test results, atmospheric exposure and a comparison of aluminum and zinc-sprayed panels, is available at 50 cents from the American Welding Society, Department T., 33 West 39th Street, New York 18, N. Y.

AMERICAN METAL CLIMAX TO OCCUPY NINE FLOORS IN NEW BUILDING

American Metal Climax, Inc., has signed a long-term lease for nine floors in the Americas Building, 1270 Avenue of the Americas, New York City. The area, comprising the 7th through 16th floors, represents approximately one-third of the total rentable space of the building.

Occupancy is expected on or before March 1, 1960. At that time the building will be renamed The American Metal Climax Building. The new space will become the executive and general offices and will consolidate the company's present offices at 61 Broadway and 500 Fifth Avenue.

The 31-story building is situated on the east side of the Avenue of the Americas, between 50th and 51st Streets. It is directly opposite Rockefeller Center's new 48-story Time & Life Building and its block-wide landscaped Plaza, scheduled to open this fall, and diagonally across from the new 42-story headquarters building of the Equitable Life Assurance Society, now under construction.

UNIVERSAL DYNAMICS ACQUIRED BY ACOUSTICA ASSOCIATES

Acoustica Associates, Inc. has acquired the Universal Dynamics Corp., Santa Barbara, California, manufacturers of piezoelectric ceramics used in ultrasonic and sonar equipment.

Universal Dynamics will operate as a wholly owned subsidiary of Acoustica. Harry W. Kompanek, who formed Universal a year ago, will continue as president of the subsidiary which has just moved into a new 7,500-sq ft manufacturing plant.

High quality piezoelectric ceramics are being used in expanding quantities as the key elements of ultrasonic systems for processing various chemicals and liquids, for ultrasonic cleaning, and for gaging liquid levels through the use of these high frequency sound waves.

ASARCO PARTNER IN MEXICAN ZINC PLANT

American Smelting and Refining Co. has joined a group of Mexican partners to form Zinc Industrial, SA. The new company will be the first Mexican producer of special high grade zinc, used principally for die-casting.

The new refining plant at Tlalnepantla, near Mexico City, is scheduled for production late this year or early next year. The first refining facilities will consist of a vertical fractionating column which will use prime western grade zinc, produced at Asarco's Rosita smelter, in the Mexican state of Coahuila.

Brass Plating Control

●

To properly operate a brass solution is difficult compared to most plating solutions. Only by careful balance of all ingredients is it possible to produce consistent results. This requires two things—Accurate solution formulation and analysis and accurate additions. Unfortunately there is much inaccurate or incomplete information published on solution formulas for brass plating and little accurate compilation of analysis. At True Brite we feel that our technical bulletin and analytical bulletin are the only complete accurate information available. There is no guesswork. We know that the rules we recommend are the key to successful brass plating. Our experience of over ten years in helping platers successfully control their brass solutions and the increasing numbers who depend on us is the best proof of real worth.

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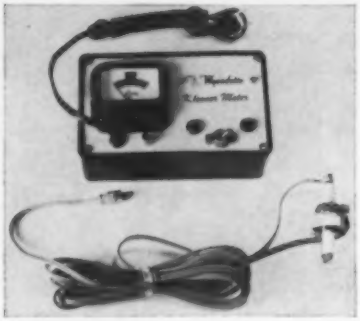

E—701. Concentration Control Meter—Now available is the Wyandotte Kleener Meter, a new concentration control meter for chemical compounds in spray washers, paint booths, phosphate installations and soak tanks.

Introduced by the J. B. Ford Division, Wyandotte Chemicals Corp., the Kleener Meter is a heavy-duty, electrically operated instrument. It includes a stainless steel probe for installation through the tank wall and into the solution, electrical leads, and complete instructions for easy installation. Needle on easy-to-read dial indicates solution strength at all times. It provides a continuous and easy method of maintaining consistent solution strength throughout day's operations. It eliminates need both for titrating solutions with each make-up and periodic checking of solution strength.

E—702. Cleaning Compound—A new acidic detergent which is said to combine cleaning, smut-removing, and prepaint-conditioning properties, has just been introduced by Oakite Products, Inc.

The new material, Oakite Compound No. 86, simultaneously cleans and improves steel's resistance to corrosion and receptiivty to paint. It is particularly useful as a precleaner to improve phosphate coatings. It is also an effective cleaner for brass, aluminum, zinc, and terne plate.

E—703. Cleaning Agent—A new cleaning agent has been announced by Tect, Inc. The product is Teclene, a solvent-detergent emulsifier. It is a yellow liquid of the viscosity of light mineral oil which forms clear solutions with all chlorinated solvents, most safety solvents and with water. It may be used straight in many cleaning operations to blend completely with oil and grease and may then be flushed off with water. It may also be added to a variety of other solvents to make them water rinsable.

Although alkaline, it may be used in the cleaning of all metals and will not attack aluminum.

E—704. Masking Discs—Masking for spray painting is said to be simplified by the introduction of "Kwiky-Dot" overlapping masking discs developed by By-Buk Co.

A feature claimed for the product is the overlapping of the discs on the rolled release liner. When several discs of the same size are required, they may be removed from the roll in connection strings and applied to the part without lost motion. A single disc may be easily removed by grasping its raised edge which is automatically raised into position each time a disc is removed.

These overlapping masking discs are claimed to be high-heat resistant and have good adhesive. They will release clean even after baking at temperatures up to 350F. By-Buk Co. has developed an anodize special tape for masking anodized, Iridite, Alodine and similar aluminum and magnesium conversion coatings, all of which have an affinity for the adhesive on ordinary masking tape.

E—705. Ultrasonic Cleaner—A mobile ultrasonic cleaning system, mounted on rubber-tired wheels, is now being manufactured to order by Acoustica Associates, Inc.

Cleaning tanks up to 75 gal capacity and ultrasonic power generators in ratings up to 2500 w can be provided. Power may be derived from a 115- or 220-v a-c outlet.

E—706. Barrel Finishing Compound—Esbec Barrel Finishing Corp. has introduced a new type of neutral, non-abrasive compound for a variety of barrel finishing operations. Esbec No. 134, in many cases, is said to replace acid compounds and eliminate the necessity for subsequent neutralizing. It can be used with chips or steel media for cleaning, light descaling, bleaching or fast burnishing operations. It is claimed to be effective for removing rust or other oxides from steel or alloys, and for bleaching, cleaning or burnishing steel, copper, brass, berylium copper, and many stainless steels. It leaves no soap film after rinsing.

As a bleaching agent, this neutral compound effectively removes dark color from parts after long cutdown runs in aluminum oxide chips or abrasive compounds.

E—707. Finishing Material—A new material said to produce a unique finish on fabricated metals at lower cost—and which gives indication of being able to reduce time and costs in the pickling operation—has been announced by Minnesota Mining and Manufacturing Co.

Already in use on stainless steel and aluminum, the material has also found successful application on zinc, brass, copper, titanium and other nonferrous metals.

Called "Scotch-Brite" brand finishing material, the product is made of nylon web impregnated with fine grades of abrasive mineral. It is not intended for stock removal.

E—708. Burnishing Compound—Patclin No. 520 stainless steel burnishing compound incorporates the newest concepts of chelation, lubrication and a buffered *p*H, to develop high lustrous finishes.

Patclin No. 520 is used at a concentration of 1–2 oz/gal water, in either a wooden barrel or in a lined steel barrel, and can be used either with shot or in a self-rolling operation.

E—709. Grinding wheel—A new raised hub disc-wheel for portable grinders has been developed by Bay State Abrasive Products Co.

The wheel's two-layer construction permits two different grinding angles so that grinding and finishing operations can be accomplished without stopping to change wheels. When the wheel is held at an angle of 30–45° to the surface of the work, it exposes the coarser-grained layer for fast stock removal from weld bead.

Held at a 10–20° angle, the wheel's second layer is brought to bear and is said to produce an excellent finish.

E—710. Atomizing Nozzle—Spraying Systems Co. announces a new 0011 series flat atomizing nozzles for spraying operations requiring a flat atomized spray at controlled and low volume. These nozzles are believed to be the smallest capacity hydraulically operated flat spray atomizing nozzles ever designed. At 40 lb pressure, rated capacity of these nozzles is two-thirds gallon per hour. Uniform atomization is obtained by hydraulic pressure alone . . . no pneumatic connection is required.

E—711. Immersion Heaters—New thermostatically-controlled immersion heaters for heating water and oil solutions in humidifiers, quench tanks, fuel oil preheaters and other applications have been introduced by General Electric.

The water heaters have a copper sheathed heating element brazed into a brass plug and a built-in thermostat with a temperature range of 80 to 220F. The oil heaters have a steel sheathed heating element brazed into a steel plug with a thermostat temperature range of 150 to 550F.

Two in. headers are used on all units. Watts density for the water heaters is 55 w/sq in. of sheath surface. Density for the oil heaters is 20 w/sq in. Over-all lengths of the heating units range from 15¼ to 45¾ in.

The new heaters can also be applied in jacketed containers, cleaning tanks, load resistors, stills and sterilizers, steam generators, impregnating waxes and alkaline baths.

E—712. Corrosion Inhibitor—Heatbath Corp. introduces a new liquid product known as Duralak that contains complex corrosion inhibiting materials and water soluble polymers. Solutions made by adding 2 volumes of water to 1 volume of it are used to apply clear, thin, hard protective coatings on all metals and conversion coatings, wet or dry, to increase corrosion and abrasion resistance and as a bond for painting, according to the company.

No specialized equipment or methods are required for its application and no toxic fumes or fire hazards are encountered, it is claimed. The solutions can be applied by immersion, brush or spray.

E—713. Polisher—Murray-Way Corp. has added to its line a junior flat polisher, designed to grind, polish and deburr flat surfaces of material with cross sections up to 12 in. by 4 in. These machines will

handle material in coil, sheets, bars, blanks, manufactured or cast parts, using an abrasive belt for either wet or dry operation. They can be arranged in tandem to perform consecutive polishing operations, and are available in models which can be fed by conveyor, pinch rolls, or coiling equipment.

Continuous, 111-in. long abrasive belts in widths from 6 to 12 in. can be used. A hand wheel on the outside of the unit enables quick, easy adjustment for changes in work thickness. Abrasive belts can be changed quickly by means of a manually operated air valve. An ammeter, mounted for easy viewing, shows the operator the motor load at a glance, and the neoprene contact roll can be dressed right in the machine at operating speeds.

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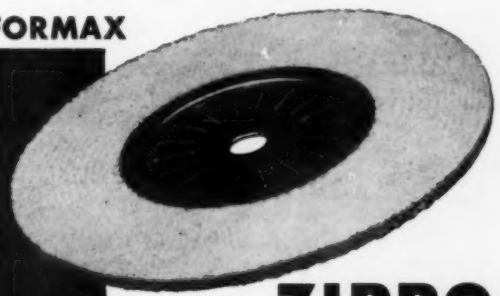

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ARTICLE REFERENCES

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Most of the articles listed here may be obtained by writing to the publications in which the articles were published. Addresses are given at the end of the references for the reader's convenience.

Photostat or microfilm copies of articles in available magazines may be obtained from: Library of Congress, Washington, D. C.; New York Public Library, New York; Engineering Societies' Library, New York, at prevailing rates. In other cases, consult Wilson's Union List of Serials at your nearest public library for other sources of these articles.

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a. *VACUUM DEPOSIT ALUMINUM FILM.*
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b. *RECTIFIERS IN THE ELECTROPLATING INDUSTRY.*
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79. MANAGEMENT

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A. T. Leonard.
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Ahmad Geneidy, W. A. Koehler, and Willi Machu.
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a. *SCIENCE FOR THE COATINGS TECHNOLOGIST. PART XIII. ADDITIVES: STABILIZERS.*
E. S. Beck.
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b. *IMPROVED PEARL ESSENCES.*
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c. *QUALITY CONTROL IN PAINT FINISHING.*
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83. PREPARATION

a. *PICKLING AND ACID DIPPING OF METALS.*
J. B. Mohler.
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B. J. Fortin, J. G. Wurm, L. Gravel and R. J. A. Potvin.
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The following are metallurgical abstracts taken from The Journal of the Institute of Metals:
February 1959 issue, pages 481, 482, and 483

Concentration Changes in the Near-Electrode Layers of Chromium Plating Baths and the Mechanism of Chromium Electrodeposition.
A. I. Levin and A. I. Falicheva.
(Zhur. Priklad. Khim., 1956, 29, (11), 1673–1684)—(In Russian). (P. 481—Chromium).

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V. P. Persiantseva, N. T. Kudryavtsev and V. M. Kalb.

(Metallovedenie i Obrabotka Metallov, 1958, (9), 42–46)—(In Russian). (P. 481—Copper).

Copper Plating From an Ammoniacal Electrolyte for Local Protection of Steel Articles During Cementation.

N. A. Marchenko.

(Zhur. Priklad. Khim., 1957, 30 (2), 248–255).—(In Russian). (P. 482—Copper).

Electrolytic Production of Alloys of Nickel With Molybdenum and Tungsten.

T. F. Frantsevich-Zabludovskaya. A. I. Zayats and K. D. Modylevskaya.

(Zhur. Priklad. Khim., 1956, 29, (11), 1684–1691)—(In Russian). (P. 483—Alloys).

Relation Between Texture and Properties of Nickel Electrodeposits.

G. S. Vozdvizhensky and R. S. Saifullin.

(Zhur. Fiz. Khim., 1958, 32, (4), 831–833).—(In Russian). (P. 483—Nickel).

April 1959 issue, pages 609, 611 and 613, 615–618

Corrosion Cracking of Brass under the Action of Cyanide Electrolyte. A. V. Shreider (Zhur. Priklad. Khim., 1957, 30, (5), 794–796).—(In Russian). Sh. (ibid., 1956, 29, 1044; M.A., 26, 181) attributed the cracking of a fuel distributor to stress-corrosion in the NH_3-contg. atmosphere. In the present investigation of fractures of another type of distributor made from Cd-plated L68 brass, tubes of this brass were half immersed for 114 days in various media to which they would be exposed during manufacture of the distributors: supply water, aq. dregs from the fuel (~ 1 per cent alkali), electrocleaning bath, pickle liquors, brightening bath, cyanide Cd-plating bath, and welding flux. Corrosion products similar to those formed in service were only formed in alkaline media. Stress-corrosion tests in the plating soln. showed cracking of the tubes, indicating that the service failures could result from retention of traces of this soln. The corrosion products were blue $Cu_2(OH)_2 \cdot CO_3$, $Cu(OH)_2$ and CuO. (P. 609—Corrosion).

Corrosion Experiences with Dissimilar Metals.

A. A. Brouwer.

(Indust. and Eng. Chem., 1958, 50, (4), 73A–74A). (P. 611—Corrosion).

Local Anodizing of Aluminium Alloys. V. G. Kononenko and D. A. Lyukevich (Trudy Khar'kov. Aviatsion. Inst., 1955, (16), 27–36; C. Abs., 52, 18013)—A description is given of a simple, cheap and dependable procedure used in aircraft production and operation for correcting flaws of the oxide film on various parts made of Al alloys, by local anodizing with DC and AC in H_2SO_4 and CrO_3 electrolytes. A diagram of a portable apparatus for local anodizing is given and optimum conditions are stated for the use of DC and AC with the above electrolytes. The corrosion-resistance, passivation, microhardness, thickness, and elasticity of the films obtained were studied. (P. 613—Aluminum).

Investigation of *p*H Behaviour (and Deposition Rate) in the Electroless Nickel Bath. L. Bosdorf and K. Muller. (Metalloberfläche, 1958, 12, (5), 150–151)—When such baths, containing $NiCl_2 \cdot 6H_2O$ 30, $(CH_3COO)_2 \cdot CO$ 2.5, and $NaH_2PO_2 \cdot H_2O$ 10 g/l, are operated at *p*H 4.5 and 97–98C with addition of $NaH_2PO_2 \cdot H_2O$ 5 g/l every 30 min the *p*H and deposition rate decrease with time, the former to 3.08 after 120 min. Increasing addition of Na glycollate as buffer have a corrective effect on both factors, the optimum value being obtained with addition of 30 g/l. Higher addition improves *p*H control but adversely affect deposition. Mg lactate behaves similarly. When glycollate and lactate are replaced by the corresponding acids there is less variation in *p*H and a higher deposition rate. (P. 613—Electroless Nickel).

Reconditioning of Cylinder Liners by Porous Chromium Plating.

V. V. Efremov and V. A. Zhikh.

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Electrodeposition of Gold-Copper Alloys.

B. S. Krasikov.

(Zhur. Priklad. Khim., 1957, 30, (5), 799–802)—(In Russian). (P. 615—Alloys).

Nickel-Plating with Periodic Reverse Current.

N. I. Zhinovich, M. M. Menkina and K. F. Rubenchik.

(Sbornik Nauch. Rabot. Belorus. Politekhn. Inst., 1956, (55), 103–108)—(In Russian). (P. 615—Nickel).

Replacement of Boric Acid in Nickel Plating.

M. E. Gol'dshtein and B. E. Korduner.

(Tekhnol. Transport. Mashinostroenyia, 1956, (7), 36–38; C. Abs., 52, 18015). (P. 616—Nickel).

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CONTAINING each of the technical papers delivered before the AES's 45th Annual Convention held in Cincinnati, Ohio, May 19-22, 1958, together with their charts, diagrams, graphs, tables and other illustrations, and with the verbatim discussion that followed their delivery, TECHNICAL PROCEEDINGS (1958 Edition) broadly enriches technical and scientific knowledge in the field of electroplating, metal finishing and allied arts.

It also includes the stenotype report of the panel session on "Practical Plating Problems" that was a hit of that Convention.

A larger book than the 1957 edition, it also carries a front section that includes a complete chronological list of AES Conventions and Past Presidents; a day-to-day log of the 45th Annual Convention; a section on the AES Scientific Achievement Award and on the Paper Awards presented at that convention; a full listing of AES's 1958-1959 Boards and Standing and Special Committees and a complete Branch Directory up to date as at September 1, 1958.

The domestic price of the 1958 Edition of TECHNICAL PROCEEDINGS is $12 per copy including postage. To those ordering from outside of the United States' continental limits, the charge is $15 per copy including postage. All orders must be accompanied by payment in full. Address orders and make checks payable to:

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A limited quantity also exists of the 1956 book at $12.50 per copy domestic; $15 per copy foreign and of the 1957 book at $10 per copy domestic and $12.50 per copy foreign. All orders must be accompanied by payment in full.

Remittance must accompany all book orders placed with AES Headquarters.

Analysis of Electroplating and Related Solutions, by K. E. Langford, F.R.I.C., A.I.M., Second Edition, Robert Draper, Ltd., England, Published December 1958, 408 pages. Non-members $9.00, AES Members, $7.20.

This book is a very useful collection of analytical methods carefully selected for a specific purpose. The methods chosen are sufficiently accurate for the analysis of plating solutions, and the author has taken great care to avoid the use of special equipment wherever it has been possible to do so.

In this second edition, the major changes are the addition of new methods using E.D.T.A., a few other new methods, expansion of the "General Notes", and a more extensive coverage of the subject of *p*H and the use of indicators. Mr. Langford has tactfully avoided over-emphasis of the virtues of E.D.T.A., and employed it only where it has a specific advantage.

There will always be differences of opinion on any subject, and some will not agree completely with the classification of methods as being most suitable for the "Plater" and the "Chemist" respectively. Your reviewer believes that the electrogravimetric methods, involving plating and weighing, are within the scope of the "Plater" if he is at all capable. The classification does, however, differentiate between the more and the less difficult methods in general. The "Frequency of Determination" recommended for each constituent would not satisfy every situation, but is eminently better than no recommendation.

Despite the fact that the British and the Americans are presumed to have a common language, some translation is required. The gallons referred to in this book are not the familiar U. S. gallons and the ounces per gallon factors cannot be used in this country. Fortunately the metric equivalents are also given from which a familiar and easy conversion is possible.

The book is very well edited. The errors in the first edition have been corrected and few, if any, new ones have occurred. The three hundred odd methods are clearly written and a short discussion of the theory and limitations of each method is given where required.

The first edition was a very useful book. The second edition should prove to be even more so.

R. A. EHRHARDT

Handbook of Practical Electroplating, by Thomas M. Rodgers, published May 1959 by The MacMillan Co. Non-members $8.50, AES Members $7.10.

The text of this book is basically sound, and in many ways excellent for the practical plater. However, there are many instances where the author could have improved his material by including information which he felt was beyond the scope of the book. While tumbling, buffing, burnishing and similar operations are not directly concerned with plating, they are an integral part of a metal finishing shop and, in the opinion of this reviewer, should receive more space in a handbook of electroplating.

Mr. Rodgers has conveyed useful, forgotten "secrets" to the plater and a novice should find it fundamental in learning how to plate. There are excellent chapters on various plating solutions, coloring of metals, etc., and many old formulas, used by the artisans years ago, are given. One such discussion is on "sand bobbing" in silver plating, now almost a lost art, but Mr. Rodgers explains it simply and intelligently. His definition of terms and methods as reference material justify the addition of the handbook to anyone's library.

The value of future editions of the book would be enhanced with some additions. For instance (1) In many cases, the author does an excellent job in discussing causes for many faulty plating deposits, but does not always tell the reader how to effect a cure. (2) Some information on important phases of plating are sometimes sketchy, and it is left to the reader to complement the material by finding it in another source. References for these omissions should be cited.

Thomas M. Rodgers is a member of the American Electroplaters' Society and the Electrochemical Society. He was president of the AES Philadelphia Branch in 1948. He attended The University of Pennsylvania and Swarthmore College. During five and one-half years in the Navy, about four were in some way connected with electroplating.

The author has been connected with the Hanson-Van Winkle-Munning Company for approximately 13 years. He is a registered professional chemical engineer in five states—Pennsylvania, Maryland, Virginia, North Carolina and Georgia.

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A limited extra quantity of the book is still available at National Headquarters for the accommodation of Branches that have not previously ordered copies. These will be sold to Branches (only), on a first-come, first-served basis so long as that supply lasts, at $5.50 per copy, including postage to one destination.

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EVERLUBE INSTALLS MODERN PLATING PLANT

EverLube Corp., No. Hollywood, Calif., has announced the opening of a new plating division.

The EverLube plating division will specialize in plating applications in the precious metal field which will include gold, silver, electroless nickel, hard nickel, rhodium.

The new plating division is located at 6940 Farmdale Ave., No. Hollywood, Calif.

TRADE LITERATURE

L—701. Dry Pickling Salts—Cleanite Products has issued an information sheet on a new dry pickling salt designated Cleanite 48 F. In field trials it is claimed baths lasted three to four times as long as muriatic acid. Add one pound per gallon of the powder to water and it is ready to use. No fumes. Can be used cold or heated.

It is said that steel pickled in Cleanite 48F will plate brighter than steel from a sulfuric or muriatic acid pickle. For brass or zinc 8 to 16 oz/gal is recommended, and for steel 16 to 32 oz/gal. Temperatures can vary from room temperature up to 160F. The bath is controlled by titration with 1 N sodium hydroxide and additions made accordingly.

L—702. Viscosity Control System—A new brochure has been published by Graymills Corp. on their new Visgard automatic viscosity control system. The system controls the viscosity of dip tanks for flow coating and roller coating, and other coating operations. The brochure tells the complete story and is well illustrated with schematic drawings.

L—703. Aluminum Finishes—A new handy-size reference "Finishes for Aluminum," containing latest information, has been made available by Reynolds Metals Co.

Starting with cleaning treatments, the booklet explains theory and method for five major types of finishing operations—mechanical, chemical, anodic, organic and porcelain enamel—including their advantages, disadvantages and costs. Its aim is to provide information needed to select the best finish for a particular application.

L—704. Industrial Floor Care—"Industrial Floors: How to Clean and Care for Them" is the title of a booklet recently published by Oakite Products, Inc.

Every type of floor has been studied and its soil removal problem solved. This booklet, complete with charts, list of cleaning compounds, and descriptions of cleaning methods, is the distillation of the knowledge gained by field representatives and chemists over the years. Methods of sanitizing, stripping wax and paint, and of absorbing liquids are also discussed.

L—705. Dialysis Separation—A comprehensive technical article on the theoretical and practical aspects of dialysis is now available from Graver Water Conditioning Co.

The article, Technical Reprint T-174, covers the basic equations involved in dialysis separation; the type and design of dialysis membranes and equipment, and industrial applications possible with Graver's Hi-Sep dialyzer.

This artlicle will be of special interest to process engineers and others in industry who deal with, or desire to perform, liquor separations involving acids, alkalis and neutral salts. Copies of the reprint are available without obligation.

L—706. Condensate Control System—A brochure is available describing the C-B system of condensate control and explaining how the "Jet Action" principal is employed. Also the names of 156 nationally known concerns in twenty-one different industries now using the C-B system for increased productions, lower steam cost, improved product quality and improved plant efficiency. This brochure (Publication 6001-B) with a "case history" of an installation is available from Cochrane Corp.

L—707. Electrocleaner—Cleanite Products, Inc. has issued an information sheet on Cleanite 78, a copper and steel heavy duty electrocleaner designed to eliminate staining and streaking prior to electroplating in fully automatic cycles. Contains a new additive to stop precipitation of metals and silicates in the rinse water, especially in hard water areas. It is said to prevent stains running down from holes or pockets in plated articles. High conductivity combined with the proper wetting and penetrating agents removes smut and dirt from deep recesses. The powder is dust-free and a controlled foam blanket stops overspray.

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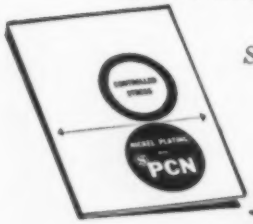

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PATENT ABSTRACTS

DR. D. GARDNER FOULKE
Manager, Electrochemical Development
Hanson-Van Winkle-Munning Co.
Matawan, New Jersey

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

No. 2,867,574, 1/6/59—Fluid Electrical Contact—E. Berry, Los Angeles, Calif.

Column 1 reads: "A device for electroplating the curved surface of an elongate cylindrical member which includes: a rigid, horizontally disposed elongate member; supporting means that permit it to be raised or lowered relative to an electro-plating tank; two supports depending downwardly from said member which are longitudinally adjustable thereon; two horizontally disposed housings affixed to the lower ends of said supports; a vertically disposed tubular member which extends upwardly from one of said housings and communicates with the interior thereof; two horizontal shafts rotatably supported in said housings and projecting from the inwardly disposed ends thereof; means mounted on the inwardly disposed ends of said shafts to removably engage the end portions of said cylindrical member for the rotatable support thereof; an elongate electrical contact member projecting downwardly through one of said tubular members to contact a body of metallic electrical-conducting fluid disposed within said housing and in contact with one of said shafts; means to rotate said cylindrical member and said horizontal shafts; an anode adjacent said curved surface; and means connecting said contact member and anode to a source of electrical power to allow electroplating of said cylinder when disposed within the confines of said tank."

4 claims, 4 figures.

No. 2,868,679, 1/13/59—Aluminum Conversion Coating—G. Pimbley, assignor to Turco Products, Inc., Los Angeles, Calif.

A bath for coating aluminum surfaces is described as containing effective amounts of Be, Mg, Ca, Sr Ba ions and a halogen. The *p*H is given as 1.3 to 2.2.

Claim 28 describes the addition of an anion in addition to the halide as one containing a group VI-A metal.

28 claims.

No. 2,868,680, 1/13/59—Pickling and Coating Stainless Steel, J. Hendricks, assignor to Devex Corp., Lakewood, Ohio.

Immerse the stainless steel in a 12 to 30 per cent pickling bath (sulfuric) containing 5 to 100 lb of sodium chloride and an activator (an alkali salt containing oxygen and sulfur with a valence less than six).

10 claims.

No. 2,868,682, 1/13/59—Chromate-Fluoride Coating Solutions—G. Dell, assignor to Parker Rust Proof Co., Detroit, Michigan.

Claim 1 states "An aqueous acidic solution for producing corrosion-resistant and paint-base coatings on metallic surfaces consisting essentially of water, at least one compound containing hexavalent chromium, at least one compound containing the fluoride radical, and at least one condensed phosphate compound

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which yields the condensed phosphate radical in solution and in which the mole ratio of cationic oxides to anionic oxides is greater than 0 and less than 3, said condensed phosphate compound being present in amounts up to about 0.5 per cent by weight calculated as condensed phosphate of sodium compound."

14 claims.

No. 2,868,702, 1/13/59—Forming a Dielectric Oxide Film on Metal—Joseph B. Brennen, Cleveland, Ohio.

Oxidize the metal at 212F to melting point of the metal to form a relatively thick oxide film compared to that normally formed in air at room temperature, then electroform an oxide film under said thermally formed oxide to form a film of high dielectric strength.

3 claims.

No. 2,868,705, 1/13/59—Electropolishing—John Bair, Manhasset and Elmer Wodetzky, Freeport, N. Y.

An electrolyte for electropolishing is described as essentially phosphoric acid containing 0.7 to 2.7 per cent by weight of sulfuric acid and 0.004 to 0.014 per cent of hydrofluoric acid. The disclosure states the electrolyte is useful for all metals except chromium and aluminum.

4 claims, 9 figures.

No. 2,868,709, 1/13/59—Feed for Plating Barrel—R. Bikales, assignor to Metal and Thermit Corp., Woodbridge, N. J.

Claim 1 reads: "In a plating machine expecially adapted for chromium plating from a chromic acid type solution comprising a tank adapted to hold the plating solution at a predetermined solution level therein, a horizontal rotatable metallic barrel adapted to be partly immersed in said solution and with which work articles therein may make electrical contact and one end of said barrel adapted to receive work articles to be plated and the other end to discharge said articles, the combination of means adapted to move work pieces longitudinally of said barrel comprising a plurality of plates arranged on edge in a longitudinal row on the inside wall of said barrel with each plate angularly disposed in the same direction to the longitudinal line of said rows of plates and each plate disposed relative to the other plates so that any plane at right angles to the longitudinal axis of said cylinder between the leading edge of one end plate and the trailing edge of the other end plate will intersect at least one plate."

3 claims, 4 figures.

No. 2,869,266, 1/20/59—Etching a Metal Surface—F. Hindler, assignor to Turco Products, Inc., Los Angeles, Calif.

The process is described as making use of a metal dissolving solution on a masked piece. "The resist is substantially less soluble in said solution than said metal and dissolving metal from the unmasked portion of said surface and substantially uniformly undercutting the periphery of said resist, by completely immersing said surface in said solution and continuously rotating said surface immersed in said solution in a plane at a substantial angle to the horizontal and on an axis transverse to said surface, to prevent the entrapment under the resist of gases liberated by the action of said solution on the metal work piece surface."

3 claims, 5 figures.

No. 2,869,267, 1/20/59—Etching Aluminum—E. Holman, assignor to Turco Products, Inc., Los Angeles, Calif.

An aluminum etching bath is claimed, being essentially an alkali metal hydroxide containing triethanolamine. Some claims also mention an alkali metal aluminate.

18 claims, 6 figures.

No. 2,870,046, 1/20/59—Rectifier—R. Van Asselt and C. Gerdes, assignors to Monsanto Chemical Co., St. Louis, Mo.

An electrical current rectifier is described as a compact mass of descrete portions of an oxide and sulfide of titanium in intimate contact with each other.

4 claims.

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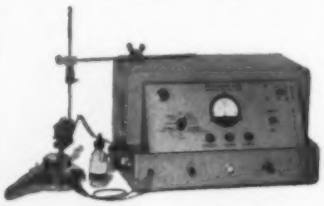

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No. 2,870,048, 1/20/59—De-enameling Process—C. Woerther, assignor to International Minerals and Chemical Corp., New York.

The use of a concentrated caustic soda solution to de-enamel wire is claimed, the improvement being adding aluminum fluoride to the caustic solution.

11 claims.

No. 2,870,068, 1/20/59—Electroformed Screens—G. Schaer, assignor to Diamond Gardner Corp., Delaware.

Claim 1 states: "A process for electroforming screens in an electrolytic cell having an anode and primary and secondary cathodes with the primary cathode between the anode and secondary cathode and having a plurality of holes therethrough, comprising non-adherently electroplating a layer of screen material on said primary cathode maintaining the ratio of primary cathode current to secondary cathode current substantially no greater than the ratio of solid area to hole area of the primary cathode, maintaining the potential difference between the anode and the secondary cathode greater than between the anode and the primary cathode, and mechanically removing said layer from said cathode as an entity."

6 claims, 7 figures.

No. 2,870,069, 1/20/59—Bright Nickel—B. Ostrow, North Bellmore and Fred Nobel, North Valley Stream, N. Y.

A bright leveling nickel process is claimed with the reaction product of a polyalkylene amine with unsaturated aldehydes and unsaturated esters of lower fatty acids. An example is crotonic aldehyde with diethylenetriamine used in the amount of 2.5 g/l along with benzene sulfonamide and 1.5 sodium naphthalene disulfonate.

5 claims.

No. 2,870,526, 1/27/59—Brass Plated Wire—O. Adler, assignor to National-Standard Co. Delaware.

Plate the ferrous wire with at least 0.00004 in. of zinc, then with a uniform ratio Cu-Zn brass at least 0.000017 in. thick prior to rubber covering the wire.

4 claims.

No. 2,871,139, 1/27/59—Silvering Process—S. Wein, Quincy, Mass.

Sensitize the plastic body with stannic chloride, then apply a silver coating by immersion in a silver salt solution containing a chelating agent (2-amino-1-butanol and similar compounds including ethylenediaminetetraacetic acid) and a reducing agent.

9 claims.

No. 2,871,140, 1/27/59—Metal Treating—N. Gross, assignor to Diamond Alkali Co., Cleveland, Ohio.

Immerse a metal (wire) in molten caustic and then lead into a molten fatty acid to cause an *in situ* formation of the hydroxide and acid.

4 claims.

No. 2,871,142, 1/27/59—Chemical Nickel and Cobalt Plating Process—S. Hayes, assignor to North American Aviation, Inc.

The use of a nickel-charged cation exchange resin to replenish nickel to an electroless nickel bath.

12 claims, 11 figures.

No. 2,871,174, 1/29/59—Electropolishing—D. Turner, assignor to Bell Telephone Laboratories, Inc., New York.

For p-type silicon surfaces make anodic in hydrofluoric acid of 2 to 10 per cent.

1 claim.

PERSONALS

C. C. Helmle has been appointed vice president and general manager of Enthone, Inc. of New Haven, Connecticut, a subsidiary of American Smelting and Refining Co. Mr. Helmle was previously vice president and sales manager and will continue as sales manager in addition to his new duties.

Mr. Helmle has been prominent in the metal finishing industry for many years. After receiving a degree in chemical engineering from Rensselaer Polytechnic Institute, he served for ten years as a plating chemist and metallurgist at the General Electric Co. plant in Bridgeport, Conn. In 1943 he was named a vice president of Enthone and has played an active role in the growth of the firm. He has published many articles on the engineering aspects of metal finishing. Bridgeport Branch. He is presently a member of the board of trustees of the Metal Finishing Suppliers' Association and chairman of their Trade Promotion Committee.

C. C. Helmle

Dr. E. B. Saubestre

Edward B. Saubestre has been promoted to technical director and **William K. Murray** to manager of marketing at Enthone. Dr. Saubestre is a graduate of Columbia University and was associated with the Research Laboratories Division of Sylvania Electric Products, Inc., Bayside, New York, before joining Enthone in October, 1958, as assistant to the research director. As technical director, he will direct the new Enthonics laboratory including research, development and technical service activities.

Mr. Murray joined Enthone in 1953 and was supervisor of the technical service laboratory for several years before becoming manager of customer service in 1957. He is a graduate of Rensselaer Polytechnic Institute and was previously employed by Wallace Silversmiths of Wallingford, Conn. As manager of marketing, he will be in charge of advertising, sales promotion, market research and public relations.

W. K. Murray

T. Sward

Ted Sward has been appointed assistant sales manager for Industrial Filter & Pump Manufacturing Co., Cicero, Ill. Previous to his present appointment, Mr. Sward served the company as a sales engineer. Before coming to Industrial, Sward was associated with Western Electric Co., Chicago.

He is a graduate of James Milliken University in Decatur, Illinois, where he earned a BS degree in 1951.

James F. Zievers was announced incorrectly in the May issue, page 527, as having been appointed president of Industrial Filter and Pump Manufacturing Co. The appointment was to vice presidency of the firm. He has been with Industrial Filter for eight years.

PLATING MAGAZINE

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Peter E. Caron has been named manager of the by-product sales department of American Smelting and Refining Co. Mr. Caron succeeds Donald K. Wright, who retired on Jan. 1 of this year, after 34 years of service to the company.

Mr. Caron joined Asarco in 1948 as a salesman in by-products sales and has remained in the department since that time.

Born in New York City in 1924, Mr. Caron attended St. Marks School in Southboro, Mass., and received a BS degree from Harvard University in 1947. During World War II, he served in the European Theater as a first lieutenant with the U. S. Army Combat Engineers.

Merle F. Koblish has been named sales manager for basic industrial chemicals produced by Allied Chemical's General Chemical Division.

Mr. Koblish succeeds Arthur E. Foell who retired Dec. 31 after 41 years with the company, serving as manager of sales the last 15.

A member of the Allied Chemical organization for 30 years, Mr. Koblish has been assistant manager of sales since 1947. Starting as a salesman in the New York office in 1929, he was later manager of the St. Louis and Washington, D. C., offices.

Mr. Koblish is a graduate of Cooper Union from which he holds a BS degree in chemical engineering. His home is at Indian Head Road, Morristown, N. J.

William E. Bridgett has been added to the sales staff of the Apothecaries Hall Division of the Hubbard-Hall Chemical Co. of Waterbury, Conn. Mr. Bridgett will cover the Southern New England territory.

Mr. Bridgett was formerly in charge of metal finishing for the Stanley-Judd Division of the Stanley Works and has more recently represented Hanson-Van Winkle-Munning in the sale of metal finishing equipment and supplies. With his wife and two children he lives in Wallingford, Conn.

Rudy Cernick has joined the American Buff Co. as sales representative in Eastern Michigan and Western Ohio.

Mr. Cernick formerly conducted his own swimming pool construction business in Chicago. He will work out of the Detroit office at 2970 West Grand Boulevard.

Harry Parsons, who has represented the American Buff Co. in Ohio and Western Pennsylvania for the past three years, has been transferred to the New England territory. He will cover the states of Connecticut, Rhode Island and Massachusetts for the company.

Mr. Parsons is a native of Connecticut and will make his headquarters in Newtown, Conn.

PREVIEW OF PLATING MAGAZINE ISSUES AHEAD

AUGUST 1959

Another annual edition of PLATING's widely anticipated WATER AND WASTE TREATMENT issue.

SEPTEMBER 1959

An issue featuring a number of important electroplating and metal finishing articles, plus many features of wide PLATING MAGAZINE readership interest, including an up-to-date copy of the AES's amended Constitution and By-laws, and a financial report covering the fifteen-month period from April 1, 1958 through June 30, 1959.

OCTOBER 1959

Several significant technical and scientific papers will be released in this strong autumn issue, plus many of PLATING's widely anticipated regular features.

NOVEMBER 1959

Third annual edition of PLATING MAGAZINE's popular AIRCRAFT ISSUE, this edition, judging by its blueprint at this stage, looms as one of PLATING's strongest future editions, a worthy follower of expectedly effective SEPTEMBER and OCTOBER 1959 general issues.

DECEMBER 1959

PLATING's always popular Christmas Issue this year implemented by several important innovations.

JANUARY 1960

Another annual edition of PLATING's vaunted "Abrasives and Mechanical Finishing" Issue.

MARCH 1960

PLATING's widely anticipated annual "Organic Coating" issue.

R. O. (Dick) Watson has been named

Division of Raybestos-Manhattan, Inc.,

NEW CHROMIUM PROCESS

Kenneth C. Davis has been named assistant general manager of Michigan Abrasive Co.

After World War II army service, and sales and advertising experience with several companies, Mr. Davis joined Michigan Abrasive Co. in 1950 as a sales representative. His work soon brought an advancement to district sales manager, embracing Michigan and Ontario.

Previously, Mr. Davis was employed on the advertising staff of Plymouth Motor Co. as assistant to the supervisor. He left there to become an account executive with Holden Clifford & Flint, a local advertising agency. Then, an offer from Textileather Corp., now a division of General Tire Co., lured him to Toledo where he served in the sales department until starting his career with Michigan Abrasive Co.

Charles D. McCarty has been issued a franchise for the distribution of products manufactured by the Schaffner Mfg. Co.

Mr. McCarty will exercise his franchise in the state of Tennessee. He has been thoroughly trained in the buffing and polishing division of metal finishing. He makes his home at 4105 Central Avenue Pike, Knoxville.

C. D. McCarty

H. E. Hirschland

Herbert E. Hirschland has been elected vice president in charge of commercial development, Metal & Thermit Corp. He previously had the title of director of commercial development.

The Commercial Development Division headed by Mr. Hirschland includes the functions of product development, market development and research.

Mr. Hirschland started with Metal & Thermit in 1941 as a process engineer in the then-newly-centralized research department. He has been involved in research, production and sales assignments since that time.

A native of New York City, Mr. Hirschland graduated from Dartmouth, class of 1939, with a Bachelor's degree in chemistry. He received the MS degree in chemical engineering in 1941 from M.I.T. He is a member of the American Institute of Chemical Engineers, the American Chemical Society, Chemists Club and Dartmouth Club.

Donald R. Meserve has been named sales manager of the Organic Coatings Division, Metal & Thermit Corp.

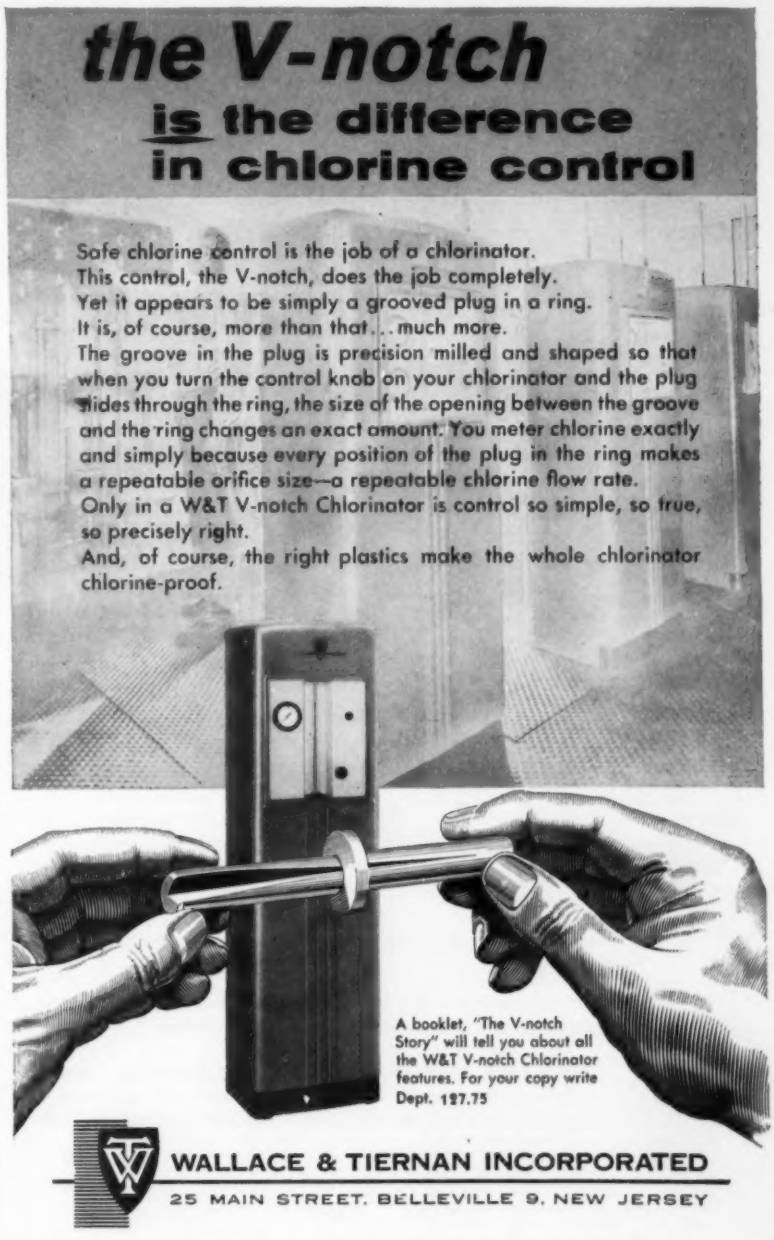
Mr. Meserve has been with the Company for 17 years, during which his responsibilities have included research and development, technical service, production, and sales.

Since 1957, he has served as chairman of the Vinyl Dispersions Division of the Society of the Plastics Industry. He is a member of the National Association of Corrosion Engineers, the National Paint and Varnish Association, and American Management Association.

Mr. Meserve is an alumnus of Middlebury College, where he received his degree in Chemical Engineering.

T. C. Tiearney has been appointed assistant sales manager of Indiana Commercial Filters Corp., Lebanon, Indiana.

In 1950, Mr. Tiearney joined the Honan-Crane Co., which was later acquired by Commercial Filters. During this entire period, he served in a sales engineering capacity on the complete line of CFC filtration equipment. He is a veteran of World War II and a graduate of the University of Illinois.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R. O. (Dick) Watson has been named sales and service engineer for the South Indiana area for Northwest Chemical Co., Detroit.

Dick Watson is well known in the plating, cleaning and industrial chemical field through his activities in the Grand Rapids area over the past ten or twelve years.

He is a chemical engineer, graduate of the University of Detroit, an officer in the National Guard, past president of the Grand Rapids Branch of the American Electroplaters' Society.

Mr. Watson has moved his family to Indianapolis where he will establish a regional office.

L. S. Hilton has been appointed manager of the abrasive and diamond wheel departments of the Manhattan Rubber Division of Raybestos-Manhattan, Inc., Passaic, New Jersey. He succeeds **J. A. Lange** who requested to be relieved of managerial responsibilities in order to devote his knowledge and 43 years experience to improving methods and quality. **C. Fleming Jr.** has been appointed production and development manager.

L. S. Hilton started with Manhattan in 1934 and was formerly sales manager. New sales executive appointments to succeed him are **S. R. Delaney,** sales manager, and **A. J. Verrinder,** assistant sales manager. Technical superintendents also appointed are **D. B. Bell** and **L. S. Benson. T. Gordon,** formerly superintendent of diamond wheel department, has been appointed field engineer for diamond wheel sales to replace **H. Ahlers** who is retiring.

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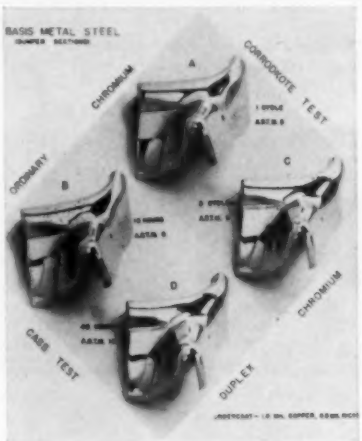
NEW CHROMIUM PROCESS

(Continued from page 852)

chromium to as much as 100 to 200 millionths of an inch—or approximately 10 times what previously was specified," according to Mr. McLeese.

Following an introduction by Mr. McLeese, Henry Mahlstedt called the attention of the press to the increased awareness on the part of major users of electroplated parts of the need for substantially increased corrosion resistance. He then explained the CASS and Corrodkote accelerated tests now used for evaluation by the industry, and the ASTM system of rating test results.

Dr. Edgar J. Seyb discussed the technical aspects of the new Duplex Chromium plating system, and presented the results of accelerated corrosion tests on both panels and actual automotive industry production parts. He also described actual results being obtained in production installations of this new system which, he said, can be adapted with minor modifications to most existing production plating operations.



In developing a successful duplex chromium process, many combinations of different types of deposits were plated and evaluated. The combination of crack-free CF-520 and SRHS Special CR-110 chromium capitalizes on the advantages of each, it was announced. The result is the present Duplex Chromium process, consisting of an initial application of bright crack-free CF-520 chromium for optimum coverage and buildup in low current density areas, followed by a second bright deposit of finely cracked chromium from a specially operated CR-110 bath.

ERRATUM

On page 707 of the Golden Jubilee Issue of this magazine, text under the photograph of T. R. Boggess read, "Annually, for years, each National President, at the Second Business Session of the Supreme Society at the National Convention, terminal date of his administration, receives the traditional silver-plated gavel of his office . . ." The word terminal should have been starting.

BRANCH NEWS

Total AES Branches U. S., Canada, Australia, June 1, 1959 — 58.

BRITISH-COLUMBIA

Plant Tour of Copper Mills

The May 13 general meeting of the British Columbia Branch took the form of a plant tour for 51 members and guests through the brand new factory of Western Copper Mills Ltd. in New Westminster.

Groups of approximately a dozen people were led on the tour by representatives of the company. In this manner it was much easier to achieve satisfactory descriptions of the various operations in the plant and enabled everyone to have their questions answered in a very satisfactory manner. The tour took us through the complete cycle of manufacture, from the raw copper in electrolytic sheet form, through the casting process, on to where the billets were extruded and finally to the subsequent drawing operations where the material was formed into the required sizes of tubing. Following the tour through the manufacturing section of the plant we were shown through the very impressive and up-to-date laboratory facilities and, finally, we visited the hard chrome plating shop, where the drawing dies are hard chrome plated.

The massive and modern machinery in the plant proved to arouse a great deal of interest. The evening was brought to a close in the plant cafeteria with coffee and sandwiches, generously provided by the company.

N. A. Shepherd
Secretary

BRIDGEPORT BRANCH INSTALLS ITS 1959-1960 OFFICERS

AES's Bridgeport Branch, born in 1914, entered its forty-sixth year as a chartered affiliate of the Society by installing its 1959-1960 Branch officers, headed by Allen Ferguson, at a meeting at the Barnum Hotel, Bridgeport, May 8. National Executive Secretary John P. Nichols installed the officers and addressed the Branch on National AES affairs. Above 1) Branch members at the early stage of the meeting. 2) The installation (left to right facing audience) Branch President Ferguson, First Vice President William Hyatt Jr., second Vice President William Lindsay Jr., Secretary-Treasurer Robert M. Parker (shaking hands), Librarian Al Jocis and Sergeant-at-Arms Emil Berger. 3) Retiring President Michael Tamas receives his Branch Past President's pin from President Ferguson; 4) The Branch hears from Executive Secretary Nichols concerning AES affairs.

BUFFALO

New Officers Elected; August Picnic Planned

The Buffalo Branch held its last meeting of the 1958–59 season May 1 at the Niagara Manor, Buffalo, N. Y.

Election of officers for 1959–60 was held and results are as follows: President, **Rolland Campbell**; vice president, **Harold Shapiro**; 2nd vice president, **John Donaldson**; 3rd vice president **John Tiebor**; secretary, **Robert Lienert**; treasurer, **Ernest Jones**; sergeant-at-arms, **Ray Blechinger**; librarian, **Richard Davis** and board of managers **Frank Rudolph, John Scholterer** and **Joe Ruff.**

Retiring President Frank Rudolph expressed his appreciation to all of the committeemen who helped make the Regional meeting a success.

Eric Sampson, picnic committee chairman, reported on the progress of the picnic committee. It was agreed to hold a basket-type picnic, similar to last year's, in the Jamestown area early in August.

The next business and educational session will be held Friday, Sept. 11, at our regular meeting place.

Robert E. Lienert
Secretary

CHICAGO

Wiesner Talks on Hard Coat Anodizing; Visitors from Japan

The Chicago Branch met for the regular monthly meeting on Friday, May 1, at the Western Society of Engineers. In the absence of **Charles Gildzahler, Matt Dassinger** conducted the business meeting. An increase in dues is imperative in order to satisfy the needs of the National Society. A very lively discussion followed regarding the amount required to help out the Society. It was decided to let the Delegates use their own judgment at the Detroit meeting in June as to the amount of increase in dues for the Branch.

Three guests from Japan, members of the Japanese electroplaters society, attended the meeting.

Simon P. Gary, librarian, introduced the speaker, **Dr. Harold J. Wiesner** of the Bendix Corp. His subject was "Hard Anodizing of Aircraft Components". His talk, illustrated with slides, covered (1) a discussion of anodizing solutions, (2) quality control of hard-coats, (3) hard-coat anodizing of high copper alloys. The solutions used for hard-coating aluminum are primary solutions of sulfuric acid, ranging from 15–30 per cent by weight, with a small amount of an organic acid (oxalic acid). In another type, the solution is saturated with carbon dioxide prior to use. Voltages may range from 25–125 v, one process uses the super-imposition of ac which permits the use of higher current densities. The temperature may range from 25–50F and the current density from 25–40 amp/sq ft. The oxide coating produced is usually from 0.001–0.002 thick but greater thicknesses can be obtained by variations in the process.

At Bendix, the quality control group developed a modified parallel circuit when

BRANCH SECRETARIES

Branch News is required of all Secretaries monthly by AES Bylaws. First of the month is Branch News deadline for next PLATING issue. Any items on hand on that date will be carried in that edition. Later arrivals will appear in the issue immediately following. In reporting talks given by speakers before the Branch, please give titles of the talks, the speakers' full identification and any other pertinent information of interest to other Branches and PLATING's broad readership.

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the amperage is controller on a test bar and an ampere hour meter to measure the current for the work load. A chart has been worked out that by knowing the area of test bar to be used with work load, the operator uses a known amperage for test bar and ampere hours, a certain thickness will be obtained on work load. To eliminate burning of the parts, 18 amp/sq ft are used for 5–10 min then raised to 36 amp/sq ft. The coating is then sealed in nickel acetate solution. The thickness of hard-coat may be checked by (1) Dermitron, (2) chemical stripping, (3) electro-limit gage. The three methods correlate for a given measurement of a hard-coat thickness.

To hard-coat alloys with a higher copper content, a high concentration of sulfuric acid (30 per cent by weight) with a low temperature was required. The current density used was 36 amp/sq ft for 20 min to obtain a thickness of 0.001. Following a question and answer period and a round of applause for Dr. Wiesner, the meeting was adjourned.

Christopher Marzano
Publicity Chairman

CINCINNATI
Kirkpatrick Discusses Plating Costs

President **Stephenson** called the March 25 meeting to order with 25 members and guests present.

The members rose to applaud Past President **Helmich** for a fine year of service to the Cincinnati Branch.

Roger Winterman reported on the recent Tri-State Annual Meeting. Mr. Winterman said that the four-Branch meeting was very successful, that everyone had an enjoyable and educational day. The Tri-State committee drafted a tentative change in the section of the by-laws pertaining to "funds." This draft will be put into final form and voted upon at a meeting of the Tri-State Committee later in the year. **Lee Howald** asked for opinions of other Tri-State representatives as to the date of next year's Tri-State. He suggested April 9. Since this date is during Lent, it was suggested that the committee try for April 23 or some other date that would not conflict with the Lenten observance.

The meeting was turned over to Librarian **Jerry Poll,** who introduced the speaker, **A. H. Kirkpatrick** of Crown Rheostat & Supply Co. Mr. Kirkpatrick discussed relative costs of hand operations and automatic plating, showing how costs of labor, materials, amortization, interest, fixed overhead and so on, enter into costs of a typical zinc cyanide plating process. A lively discussion was carried on during and after Mr. Kirkpatrick's talk.

The social hour that followed the meeting was sponsored by the Udylite Corporation, with **Art Gerada** as host.

David L. Kaplan
Secretary

DETROIT
Geissman Talks on Mechanical Finishing

Friday evening, May 1, the executive board of the Detroit Branch of the American Electroplaters' Society met at the Statler Hotel prior to the regular Branch monthly meeting. **Donald M. Bigge,** president-elect of the Detroit Branch presided in the absence of the President, **Manuel Ben.**

Edward J. Kubis, secretary-treasurer, reported on a letter received from the Toronto Branch regarding the annual Regional Meeting on May 2 at the Sheraton Brock Hotel, Niagara Falls, Ontario, and inviting the Detroit members to attend. Mr. Kubis also read a letter from the Boston Branch inviting the Detroit members to attend the 23rd Technical Session of the Boston Branch and a dinner-dance to be held at the Statler Hilton Hotel also on May 2.

The executive board voted to present to the members a recommendation to support the increase in membership dues to the $10 requested.

Cleveland F. Nixon, chairman of the long range planning committee, reported that several meetings had been held and that the items secured had been presented to the executive group for action.

It was agreed that a letter is to be sent to all the members of the Detroit Branch over the signature of the Branch president, calling their attention to the Exposition and Convention, giving in detail the program and the hours of operation.

The Branch meeting which followed immediately was attended by 150 members and guests. It was addressed by **W. C. Geissman,** of the National Lock Company, Rockford, Illinois, on the subject, "Mechanical Finishing of Metal Surfaces", (Project 18). Following the meeting there was the customary social hour with refreshments.

R. C. Trees
Publicity Chairman

HARTFORD
Wiesner Presents Aluminum Coatings

The regular Branch meeting was held at the Hotel Bond on April 20 and 47 members and guests were present. Preceding the meeting a movie in color entitled "Secret Cargo" was shown.

The guest speaker for the evening was **Dr. Harold J. Wiesner** of the Bendix Aviation Corp., whose subject was "Hard Coatings of Aluminum".

Parts formerly made from steel are now being made from aluminum to save weight and are being hard anodized with coatings of Alumilite or Martin hard coat. These coatings approach the hardness of chromium plating and are deposited from baths using sulfuric acid and oxalic acid or other organic acids. For a given thickness of coating, 50 per cent replaces the aluminum that has been eaten away and the other 50 per cent is build up. Nickel acetate sealers are used and this may also be used as a stop off if one section is to be heavier coated. Chromic acid and phosphoric acids are used as a strip for these coatings. Many slides were shown on how the thickness builds up from various baths and samples of the coatings were shown on test samples.

The technical chairman for the evening was **Harry Sanders.**

Stanley Platoz
Secretary

HARTFORD

New Officers Installed; Chesworth Discusses Barrel Plating

The regular Branch meeting was held at the Hotel Bond on May 18, and 46 members and guests were present. Preceding the meeting a movie in color entitled "Goggles and Gauntlets" was shown. Art Logozzo then installed the new slate of officers: President, **Armand Faucher;** first vice president, **Walter Dyber;** second vice president, **Stanley Grabowski;** secretary, **Stanley Platoz;** treasurer, **Joseph Loersch;** educational advisor, **Edward Crandall;** educational committee, **Ruel Katz,** chairman, **Robert Michaud, Robert Tiers;** board of managers, **Arnold Johnson, Walter Acker** and **Arthur Logozzo.**

The guest speaker for the evening was Leonard Chesworth of United-Carr Fastener Corp. whose subject was "Barrel Plating". Barrel nickel was discussed and its maintenance to obtain uniform and consistent appearance and plate thickness. Solution must be controlled within the required limits, it is filtered and treated every 12 weeks in purification tanks with potassium permanganate and nickel carbonate and given a treatment of electrolytic purification at low current density. Brightener concentration is controlled as too high a concentration can produce a brittle plate.

Cyanide copper and brass were described as being simple baths to control and liquid concentrates were used to maintain these baths.

Barrel zinc was described and the use of first a hot dull zinc and then followed by a bright zinc. The first bath is used at a higher concentration to give high speed plating. Zinc metal content was controlled by the use of the right amount of zinc and steel anodes. To avoid high brightener consumption, make sure that it is all in solution before adding it to the bath and add it to the circulation system at the end of the plating cycle. Variations in plating thickness can be caused by poor contacts, different sized perforations in the barrel and non-uniformity of loads.

Some discussion on statistical analysis for barrel plating was covered as also barrel chromium.

The technical chairman for the evening was Walter Dyber.

Stanley Platoz
Secretary

MONTREAL

Beckwith Speaks on Duplex Nickel

The regular monthly meeting of the Montreal Branch was held on May 4 at the Sheraton-Mount Royal Hotel. The meeting was called to order by our president, **John Serbeniuk,** with 30 members present. **L. Decaire** introduced **Dr. M. M. Beckwith** of Harshaw Chemi-

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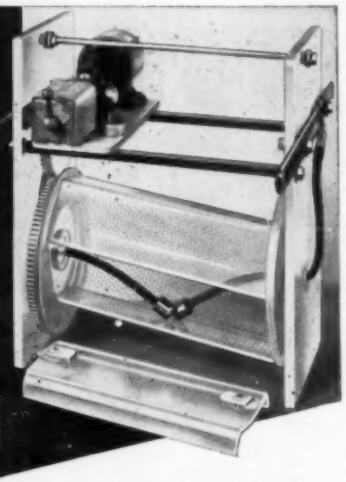

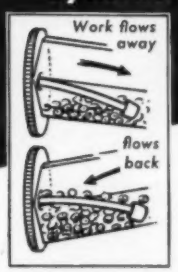

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cal Co., Cleveland, Ohio, our speaker for the evening. Dr. Beckwith gave a very interesting and enlightening talk on Duplex Nickel and corrosion resistance. He was thanked on behalf of the Branch by **J. T. Reisenburg Jr.**

A date for our fifth annual dinner-dance was set for October 3, 1959 at the Queens' Hotel. The committee for the dinner-dance will be chaired by L. Decaire. The Branch approved an application for membership. The president called upon our senior officer **J. T. Reisenburg** to install our duly elected officers for the forthcoming year. **G. Ross Davidson** expressed appreciation on behalf of the branch to him for doing such a wonderful job.

Our newly elected President **R. Takeuchi** said he and his fellow officers would do their utmost for the continued success of the Montreal Branch in the ensuing year.

R. W. Niggemann
Secretary

NEWARK
Foulke and Knapp Address Own Branch

Some 75 members attended the May 15 meeting of Newark Branch, President **Meyer** announced that the Metropolitan Regional meeting with New York was scheduled for September 1959 at New York. The Branch voted in favor of this joint meeting. A new member was elected. The matter of an increase in dues was discussed at some length with Messrs. **Wesley** and **Nichols** pointing out the need for it. **John Banta** presented the motion approved by the Executive Committee that the delegates be instructed to vote for no more than a $2 a year increase. **Dr. Foulke** asked that the motion be modified to the extent that "the Branch favors an increase in per capita tax at this time not in excess of $2 a year and that the delegates go uninstructed but aware of the Branch feeling. This was passed. It was also moved and passed that delegates and alternates to the Convention be paid up to $100 for expenses unreimbursed by their companies. Don Foulke was introduced by John Banta, librarian for the evening, and he discussed advances in nickel plating with particular emphasis on duplex coatings. The talk was kept brief because of the long business meeting and the fact that the speaker was on crutches as the result of an infected foot. **Dr. Burt Knapp** then gave the principle talk of the evening on "Gases in Electrodeposits." Dr. Knapp explained how gases could be determined and discussed the problem of hydrogen in bright nickel. The talk concluded with a discussion of Edwards' recent paper which showed the H, C and O increase in bright nickel deposits with increased bath use.

D. Gardner Foulke
Secretary

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PHOENIX

Rockets and Missiles Presented by Schwartz of Phoenix Branch

Thirty-four members and guests attended the May meeting of Phoenix Branch held at our usual meeting place, the Naval Reserve Officer's Club, 17th Avenue & Osborn Road.

After the usual delays of rounding-up the members from the bar and of getting the food orders straight, the meeting started at 8:30.

Our speaker, **Dr. Frederick Schwartz,** president of W. S. Semi-conductor gave an excellent presentation on the subject of "Rockets and Missiles, Past, Present & Future." The interest shown and questions asked, indicated that occasionally subjects other than electroplating will be a welcome change of pace.

The business meeting held after Dr. Schwartz's speech was called to order by President **Bill Griff.**

Discussion on the subject of summer meetings resulted in a decision to hold a swim party and dinner next month. **Bob Axsom** and **John Mullarkey** are to make necessary arrangements.

One new application for membership was submitted.

James E. Weaver
Secretary

ST. LOUIS

McAlister Tells Fellow Members About Alloy Barrel Plating

The regular monthly dinner meeting of the St. Louis Branch was held at the York Hotel Wednesday, May 13 with 17 people present for dinner and 31 at the business meeting. Communications consisted of a letter from headquarters asking that we send a letter inviting the convention to St. Louis since we had not done so up to that time.

Three new members were elected on a motion by **William Piel** and a second by **Louis Berra.**

Andy Julius reported on the Mid West Regional meeting which he attended at Milwaukee. He said that it was agreed that the per capita tax should be raised and that the Branches represented nearly all agreed that $8 would be the maximum their delegates would be instructed to vote for at the business meeting in Detroit this June.

Louis Berra reported for the school. He told us that our school received a Federal grant of $250 because it was among the top classes. The money will be used to buy a *p*H meter. **Dr. Otto Klein** the instructor was present to present the diplomas to Louis J. Berra, **William George, John Cassani, Maurice V. Devitt, William Piel, James O. Harriman, Louis W. Voelker. Charles E. Sweeney** and **Melvin C. Elder.** A special hand was given Otto for his excellent job.

It was gratifying to hear that **Craig McAlister,** past president of our Branch, would serve on the educational committee for the 1962 Milwaukee Convention. **Andy Julius** another past president and presently a delegate from our branch was notified he would serve on the Honorary Membership committee. It is good to see these fellows who have worked so hard for our branch gain the recognition they so justly deserve. **L. A. Davies** was called upon to install the officers for the coming year. William Piel was installed as president. **George Koderhandt** 1st vice president and **Homer Thomen** 2nd vice president were absent. **Ward Kelly** and Louis Berra retained their offices, secretary and treasurer respectively. **Richard Gotsch** was installed as librarian and **Pete Young** as Sergeant-at-arms.

Richard Gotsch introduced our speaker of the evening, a member of our Branch, past president, former delegate and board of governors member, Craig McAlister of

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Bussmann Mfg. Co. who talked on "Bright Alloy Barrel Plating." He related how he overcame many of the difficulties encountered in copper-tin-zinc alloy plating. Craig exhibited many samples of his parts presently being processed in the alloy plate. **Clarence Mange** a prominent consultant in St. Louis also a member of our Branch had helped Craig during his trying times and was on hand to lend his knowledge to the discussion. A very active question and answer period followed the talk.

Ward Kelly
Secretary

SEATTLE-PUGET SOUND

Millard Speaks on Plating Power

The May meeting of the Seattle-Puget Sound Branch was held May 19, at Andy's Diner.

A very short business meeting which included nominations of officers for the coming year was the chief item of business. The speaker for the evening was a member of the local Branch, **George Millard,** of the Electro-Chrome Co, Inc. Seattle, Washington.

Mr. Millard gave a talk on "Power for Electroplating," discussing rectifiers and generators, the advantages and disadvantages of each and some of the possible new developments for each.

Helen Archibald
Secretary

SOUTHERN TIER

McGraw Presents Paper on Hydrogen Embrittlement

Our regular monthly meeting was held at Lou's Grill, Johnson City, N. Y. Tuesday, April 21. About 30 members and guests were in attendance for the dinner and meeting. President **Morgan Rake** opened the meeting by appointing **R. Ingram,** chairman of the summer picnic. Results of the 1959–1960 election of officers were as follows; **Charles Emery,** president; **Charles Cordier,** vice president; **Bill Rossiter,** secretary; **Bruce Wells,** treasurer; **Holger Andreason,** librarian.

President Rake introduced the speaker, **Les McGraw** of Battelle Laboratories, Columbus, Ohio. His topic was "Hydrogen Embrittlement of Metals." Along with a very fine technical discussion, Mr. McGraw reported also on new methods and devices used in the testing of metals for hydrogen embrittlement. An interesting question and answer period followed Mr. McGraw's fine talk. The May Meeting will be a plant tour of Mercury Aircraft in Hammondsport, N. Y.

Bill Rossiter
Secretary

SPRINGFIELD

Logozzo Talks on Chrome Plating

The Springfield Branch met at Blake's Restaurant, on Monday, April 27, to hear Mr. Chrome Plater, himself, none other than **Arthur Logozzo,** president and founder of Nutmeg Chrome Corp. of West Hartford, Conn. Art had a brand new paper which he discussed, called "Chrome Plating Solutions in Use Today." Also, there was a new film on polishing of molds, and the use of ultrasonics as a medium for descaling.

Although I was not present, (first meeting I missed in my seven years as a member), I understand the response to both the film and the speaker was a terrific ovation to the popularity and knowledge of Art Logozzo. Thank you, Art!

Arthur Zavarella, in his Five Minute Review, spoke on Chrome Plating on Titanium, published in the February 1959 *Products Finishing* magazine, and a comparison was made with the National Bureau of Standards methods. Art's talks are brief, but contain a lot of meat.

Robert Girard introduced and gave a word of welcome to **Francis Crowley,** chief of the Industrial Lab. at the Springfield Armory, and to **Leo Diamond** of Hampden Color and Chemical Co., who were attending their first meeting as new members of the Springfield Branch.

Alexander Salmond gave a brief report on the third annual golf outing, installation of officers, and banquet, on May 23. This is the final meeting for this season. The program is completely arranged and produced by the activities committee.

Henry L. Heissfeld
Secretary

TORONTO

Lux Talks on Electro Cleaning

The Toronto Branch held its last meeting until the fall, on Friday May 8 at the Royal York Hotel. **Bob Edwards** presided. This being our annual Past Presidents' Night, six of our tried and true ex-presidents were guests of the Branch. Twenty-one sat down to dinner. Refreshments and Prize were donated by Oakite Products.

Forty-two attended the meeting to hear **Gerry Lux,** director of technical education at Oakite. His subject was "Fundamentals of Electro-cleaning"—a very interesting evening. Gerry was still answering questions long after the curtain was run down on another successful year. See you in September when **Ray Day** will take the chair.

A. W. Wilson
Libriarian

WATERBURY

Tirendi Heads New Slate; Old Timers Program

The Waterbury Branch had its final meeting of the season at the Hotel Elton on May 14. The first major item of business was the installation of the incoming officers. **Bill Coleman** did a fine job as installer. The officers elected and installed were as follows: President, **Frank Tirendi;** 1st vice president, **William C. Giesker;** 2nd vice president, **Louis Porretti;** librarian, **P. R. Mazzamaro;** assistant librarian, **S. L. Doughty Jr;** publicity, **Francis A. Schneiders;** research chairman, **Raymond L. Mitchell;** secretary-treasurer, **James R. Kennedy;** board of managers: **Edward J. Garland, Spencer L. Henn, Theodore Voyda.**

The second feature of the evening was an Old Timers program. Waterbury Branch which, to the best of our knowledge, was the sixth in the nation dates back to 1921 when it had 22 Charter Members. Of the original members eight are still active and four attended the meeting. Secretary **Al Griffith** read from the minutes of the meetings of the early years and assisted by a panel of charter members developed the early history of the Branch. The Charter Members present were **William Coleman, William Gray, Joseph McConas** and **Joseph Muscio.**

Francis A. Schneiders
Publicity

WESTERN ONTARIO

Lux Speaks on Metal Cleaning

A good representation of the membership was on hand to hear **Alex Corbit,** chairman of the nominating committee, bring in the selection of officers; all were elected.

The new officers are: President, **Leo Horodyski;** vice president, **Jim Marshall;** librarian, **John MacKay;** secretary-treasurer, **Bob Dobson;** past president, **Dave Mainland.**

Alex Corbit introduced the speaker **G. A. "Gerry" Lux,** director of technical education at Oakite. Mr. Lux reviewed "Fundamentals of Metal Cleaning." The members were fascinated with the talk and illustrations. Maybe a few of us had forgotten the principles of cleaning. Mr. Lux was very generous with his explanations and answers to questions after his talk. He did a fine job with a subject that everybody knows "everything about it."

Norm Southern thanked the speaker in his inimitable way.

Leo Horodyski
Vice President

AES MEMBERSHIP REPORT

ELECTIONS

Capitol District: M. E. Gunnet

Chicago: J. A. Armstrong, R. G. Bergquist, G. W. Dwyer, H. E. Gowdy, W. P. Haberland, A. R. Klomps, L. J. Kocour, Jr., F. J. LeLuan, W. C. Sievert, F. J. Trembacki, C. G. Wittleder

Dayton: F. O. Guerin

Denver: F. D. Beil Jr., H. J. Bourgeois, J. Cerenzia, D. Coston Jr., F. J. Darden, J. A. Edwards, E. F. Goecker, A. Hebeisen, V. D. Heinze, G. R. Herrick, R. E. Hoagland, G. O. Hulse, C. R. Johnson, J. F. Lewis, P. P. Lucntuorto, L. Major, H. E. McAbee, M. B. McCrady, C. R. McMullen, A. J. Mensborn, V. D. Pilger, E. D. Poucher, C. F. Quintana, A. L. Rasmussen, E. A. Schuster, C. Thomas, O. T. Towner, R. L. Whyman

Detroit: G. W. Bird, E. M. Bunjac, T. Hunzicher, J. H. Kerrigan, W. H. Ross Jr.

Grand Rapids: H. K. Klimek, E. M. Marcin, N. C. Post Jr., E. Schmuker

Hartford: J. Bass, F. R. Kukish, J. H. Sizer Jr.

Kansas City: R. A. Nederman

Lancaster: D. G. Carrol

Milwaukee: C. McNeeley, D. J. Michalski, D. W. Pottorff, J. M. Sliney, K. Varndell, T. R. Williams

Montreal: D. Lamarche

Newark: E. Doyle

New Haven: M. J. Bonassar, M. E. Burr, H. B. Cawthra, P. B. Daniels, S. S. Salvaggio

New York: P. D. Stransky

Philadelphia: M. R. Bisher, F. M. Sullivan

Phoenix: R. C. Axsom, H. L. Emerson, D. E. Gropp, R. Hylton, J. R. Maggard, R. L. Osborn, F. E. Saurette

Providence-Attleboro: F. P. Avanzo, K. Blackler, C. R. DuBuc, S. Franchina, E. J. Lavoie, A. P. Marandola, J. A. Powers, J. M. Silva, J. T. Turcotte

St. Louis: J. R. Cassani, M. C. Elder, J. L. Rice

Seattle-Puget Sound: J. Tulumello

Toronto: M. Carstensen, W. A. Ehrenschneider, L. Goodden, C. A. Purdy

Member-at-Large: E. D. Chapman, Lancs, England; W. Fletcher, Lancs, England; E. A. Fonseca, Sao Paulo, Brazil; G. Holliday, Cheshire England; E. W. Johnson, Cheshire, England; G. Netto, Sao Paulo, Brazil; W. R. Neu, Maplewood, N. J.; R. Peek, Yorks, England; T. E. Pollard, St. Helens, England; E. M. Weaver, Houston, Texas

REINSTATEMENTS

Chicago: M. Brave

Grand Rapids: R. B. Chalker

Hartford: R. Englehart, D. Colavecchio, N. Parmelee, C. Tucker

Milwaukee: A. Butschke, H. J. Durnford, J. H. Durnford

Member-at-Large: D. vander Horst, Basel, Switzerland

TRANSFERS

Chicago: C. Bellm Jr., from Cincinnati; J. H. Berg, from Mississippi; F. B. Bryant, from Mississippi; A. J. Cornish, from New York; H. G. Pahlow, to Denver; R. Tefft, to Cleveland

Cincinnati: C. Bellm Jr., to Chicago

Cleveland: R. C. Smith to Pittsburgh

Dayton: B. R. Julian to Grand Rapids

Denver: P. L. London from Member-at-Large, R. Martin from Los Angeles, H. A. Schoonover from Los Angeles

Detroit: J. R. Heizmann to Philadelphia

Grand Rapids: R. B. Chalker to Chicago, B. R. Julien from Dayton

Kansas City: J. H. Jenkins to Denver

Newark: R. Preston to Philadelphia

Philadelphia: J. R. Heizmann from Detroit

Phoenix: Dr. C. Crowley from Los Angeles, W. Griff from Member-at-Large, J. E. Weaver from Dallas-Fort Worth

RESIGNATIONS

Cincinnati: W. Harding, J. Luchi, R. Osborn

Cleveland: N. G. Hammerle Jr.

Detroit: H. Eason

Philadelphia: C. B. Ricca, R. L. Smith

Providence-Attleboro: R. Rosa, M. Ross

SUSPENSIONS

Hartford: N. Manning

Lancaster: C. O. Brandt, P. Edmund, A. W. Hagen, C. Turner

Milwaukee: B. G. Allen, B. Badeusz, S. Dexter, E. Dalciden, W. Draeger Jr., W. Edwards, W. Froscher, C. R. Jones, S. Mey, G. McCormick, E. Robinson, F. Schneider, E. Schultz, E. Schultz, H. Schultz, W. Timple, C. Toney, W. Vogel, J. C. Wagner, H. Weiley, H. B. Williams, O. Winfield

Montreal: B. Semeniw

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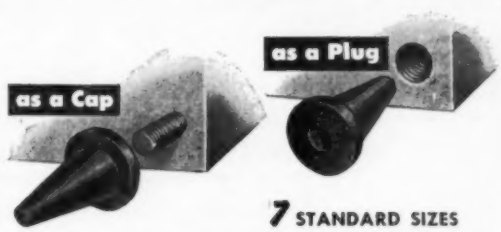

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August 22, 1959—**Detroit Branch Stag Day,** Glen Oaks Country Club, Farmington, Mich.

September 25, 1959—**Metropolitan Regional Educational Meeting,** Joint meeting New York and Newark Branches, New York Host Branch, Penn-Top Room, 8 p.m., Hotel Statler, New York, N. Y.

October 3, 1959—**Montreal Branch,** 5th Annual Dinner-Dance, The Queen Elizabeth Hotel, Montreal, Canada.

January 15-16, 1960—**Second Annual Dixie Regional Technical Session,** Saxony Hotel, Miami Beach, Florida. Sponsored by Miami Branch with Blue Ridge and Southeastern participating.

April 23, 1960—**Sixth Tri-State Regional Meeting,** Cincinnati Host Branch, Sheraton-Gibson Hotel, Cincinnati, Ohio.

April 29-30, 1960—**Sixth Empire State Regional,** Southern Tier Host Branch, Mark Twain Hotel, Elmira, N. Y.

July 24-28, 1960—**47th AES Annual Convention,** Hotel Statler, Los Angeles, Calif.

June 18-23, 1961—**48th AES Annual Convention,** Hotel Statler, Boston, Mass.

June 25-28, 1962—**49th AES Annual Convention,** Schroeder Hotel, Milwaukee, Wis. Sponsorship Midwest Regional Council.

June 24-27, 1963—**50th AES Annual Convention,** Ambassador Hotel, Atlantic City, N. J. Sponsorship Newark Branch.

INTERSOCIETY

September 21-25, 1959—**Instrument Society of America,** 14th Annual Instrument-Automation Conference and Exhibit, International Amphitheater, Chicago.

October 7-9, 1959—**American Vacuum Society,** Sixth National Symposium on Vacuum Technology, Sheraton Hotel, Philadelphia, Pa.

October 11-16, 1959—**American Society for Testing Materials,** Pacific Area National Meeting (with Exhibit), Sheraton-Palace Hotel, San Francisco, Calif.

October 18-22, 1959—**The Electrochemical Society,** Fall Meeting, Deshler-Hilton Hotel, Columbus, Ohio.

October 21-24, 1959—**Federation of Paint and Varnish Production Clubs 37th Annual Meeting and 24th Paint Industries Show,** Convention Hall, Atlantic City, N. J.

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Executive Secretary.....JOHN P. NICHOLS
445 Broad St., Newark, N. J.

November 2-6, 1959—**41st National Metal Exposition & Congress,** International Amphitheatre, Chicago, Ill.

November 5-7, 1959—**American Chemical Society,** Southeastern Regional Meeting, Symposium on Corrosion of Iron and Tin, Hotel John Marshall, Richmond, Virginia.

Nov. 30-Dec. 4, 1959—**27th Exposition of Chemical Industries,** New York Coliseum, New York City.

January 12-15, 1960—**Society of Plastics Engineers**—16th Annual Technical Conference, Conrad Hilton Hotel, Chicago, Ill.

May 1-5, 1960—**The Electrochemical Society,** Spring Meeting, LaSalle Hotel, Chicago, Ill.

July 24-26, 1960—**National Association of Metal Finishers,** 5th Anniversary and Membership Meeting, Hotel Statler, Los Angeles, California.

July 25-26, 1960—**National Association of Metal Finishers,** 5th Anniversary Management Seminar, Hotel Statler, Los Angeles, California.

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